SOIL SURVEY OF

San Bernardino County Southwestern Part, California

United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of California
Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1971. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1971. This survey was made cooperatively by the Soil Conservation Service and the University of California Agricultural Experiment Station. It is part of the technical assistance furnished to the West End and the Redlands-Highland-Yucaipa Resource Conservation Districts.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of San Bernardino County, Southwestern Part, are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetical order by map symbol and gives the capability classification and Storie index rating of each. It also shows the page where each soil is described and the page for the capability unit in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the section "Engineering Uses of the Soils," and "Use of the Soils for Recreational Development."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "How the Soils Were Formed and Classified."

Newcomers in the area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

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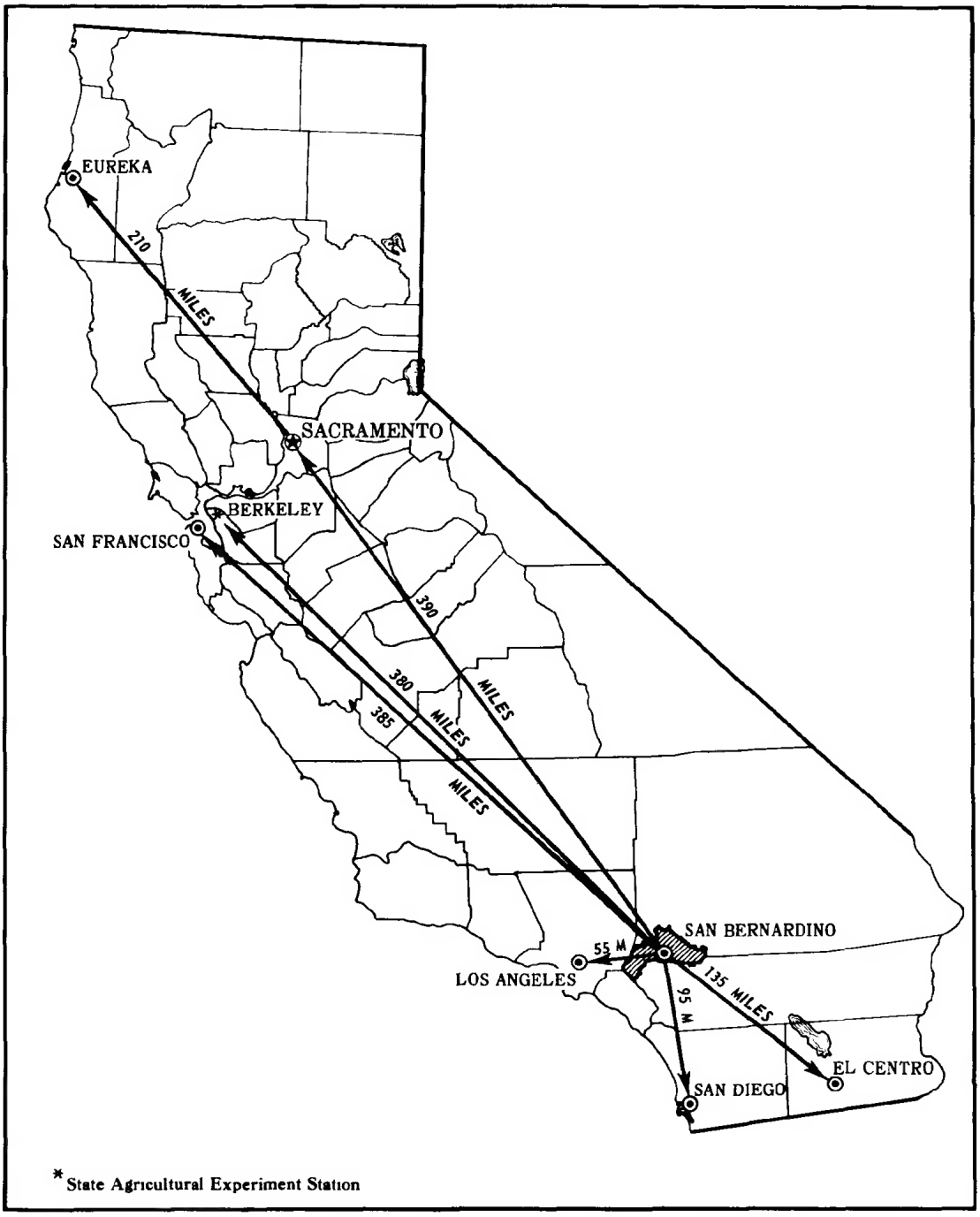

Location of San Bernardino County, Southwestern Part, in California.

SOIL SURVEY OF SAN BERNARDINO COUNTY SOUTHWESTERN PART, CALIFORNIA

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United States Department of Agriculture, Soil Conservation Service in cooperation with the University of California Agricultural Experiment Station

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, is in the central southern part of California and makes up the southwestern corner of San Bernardino County. It consists of that part of San Bernardino County that is east of Los Angeles County and the northeastern part of Orange County. The San Bernardino National Forest forms the northern and eastern boundaries. The city of Los Angeles is about 35 miles to the west. The survey area is roughly rectangular and averages about 40 miles from east to west and 12 miles from north to south. The total extent of the survey area is approximately 296,880 acres, or about 464 square miles.

The soils in the survey area are nearly level to steep and are suitable for many kinds of crops. Dry farming and grazing of livestock take place in the southwestern foothills and eastern and northern uplands that are adjacent to the San Bernardino Mountains.

Irrigation was introduced in the 1820's by Spanish missionaries and soldiers who planted small gardens, orchards, and vineyards. Settlers in the early 1850's brought a revived interest in farming and put more land under cultivation. Orange trees were planted in the late 1850's. The wine industry also became of economic importance.

This southwestern part of San Bernardino County is noted for its highly intensified farming. The irrigated areas are used for citrus, apples, grapes, alfalfa, and a wide variety of truck crops. Permanent pasture, silage, and other forage crops are used by the dairy industry that is concentrated near Chino and Ontario. In the dry-farmed areas, barley and oats are grown.

Since the early 1950's farming has been in keen competition with the extra demands on the land for industry, housing, highways, and many other nonfarm uses. Urban encroachment and high taxes are also serious problems that farmers must contend with.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in San Bernardino County, Southwestern Part, where they are located, and how they can be used. The soil scientists went into the county knowing they were likely to find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the kinds of native plants or crops, the kinds of rock and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Fontana and Oak Glen, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Sorrento clay loam, 0 to 2 percent slopes, is one of two phases within the Sorrento series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show roads, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping

units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. The mapping units of this kind shown on the soil map of San Bernardino County, Southwestern Part, are soil complexes.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Cieneba-Friant sandy loams is an example.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in San Bernardino County, Southwestern Part. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in San Bernardino County, Southwestern Part, who want to compare different parts of the survey area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management. Not all soil boundaries and names on the general soil map of this survey area join with those on the map of the Western Riverside Area, California, that was surveyed earlier. Most of these differences result from differences in map scale and from the continuous refinement of the current system of soil classifications.

The soil associations in this survey have been grouped into two general kinds of landscapes for broad interpretative purposes. The first of these broad groups is further subdivided on the basis of color, or texture, or both. Each of the broad groups and their soil associations are described in the following pages.

Soils of the Alluvial Valley Floors, Fans, and Terraces

This region is made up of the alluvial valley floors, fans, and terraces that cover broad areas throughout the central part of the survey area. It extends eastward from Los Angeles County, near Chino, to the general vicinity of Yucaipa. Most of the northern boundary is the San Bernardino National Forest.

Elevation in this region ranges from 600 to 3,400 feet. The average annual rainfall is 12 to 18 inches. Annual grasses, forbs, and some chamise make up the plant cover. The six soil associations in this region make up about 82 percent of the survey area.

1. Hanford-Greenfield-San Emigdio association

Nearly level to moderately sloping, well-drained, very deep soils on alluvial valley floors and fans

Areas of this soil association are near San Bernardino, Redlands, Yucaipa, and Upland. The soils formed in alluvium derived mainly from granitic rock. Slopes range from 0 to 9 percent. Elevation ranges from 1,000 to 3,400 feet. The average annual rainfall is 12 to 16 inches, the mean annual temperature ranges from 61° to 65° F, and the frost-free season is 230 to 280 days. Vegetation consists mainly of annual grasses and forbs, but chamise grows in scattered areas.

This association makes up about 18 percent of the survey area. Hanford soils make up about 70 percent

of the association, Greenfield soils about 15 percent, San Emigdio soils about 10 percent, and minor soils 5 percent.

Hanford soils have a surface layer of pale-brown, slightly acid sandy loam. Below this is pale-brown or very pale brown, neutral sandy loam.

Greenfield soils have a surface layer of pale-brown, slightly acid sandy loam. Their subsoil is yellowish-brown and light-brown, slightly acid, fine sandy loam. The underlying material is light yellowish-brown, neutral sandy loam.

San Emigdio soils have a surface layer of light brownish-gray, moderately alkaline fine sandy loam. These soils are calcareous throughout.

Minor soils in this association are in the Oak Glen, Metz, and Monserate series.

The soils of this association are used for irrigated and dryland crops. They also are used for limited grazing. Some areas are used for homesites and related uses.

2. *Grangeville-Chino-Hilmar association*

Nearly level, somewhat poorly drained, very deep soils in basins and on alluvial flood plains and fans

Areas of this soil association are south and southeast of Chino. The soils formed in alluvium derived from granitic rocks. Slopes range from 0 to 2 percent. Elevation ranges from 600 to 1,200 feet. The average annual rainfall is 12 to 16 inches, the average temperature ranges from 61° to 65° F, and the frost-free season is 230 to 310 days. Vegetation consists mainly of annual grasses and forbs.

This association makes up about 7 percent of the survey area. Grangeville soils make up about 40 percent of the association, Chino soils about 30 percent, Hilmar soils about 20 percent, and minor soils 10 percent.

Grangeville soils have a surface layer of grayish-brown, calcareous, strongly alkaline fine sandy loam. Below this is light brownish-gray, calcareous, strongly alkaline fine sandy loam. In places the Grangeville soils contain moderate amounts of soluble salts and are strongly affected by alkali.

Chino soils have a surface layer of gray silt loam. Their underlying material is gray silty clay loam. Chino soils are moderately alkaline and strongly calcareous throughout. They formed in areas where drainage was somewhat poor, but drainage has been altered and the water table lowered by pumping irrigation water. Thus wetness is no longer a problem.

Hilmar soils have a surface layer of grayish-brown, moderately alkaline loamy fine sand. Below this is light yellowish-brown or grayish-brown mottled loamy sand. This is underlain by light brownish-gray, mottled loam stratified with many thin lenses of sandy loam and loamy sand.

Minor soils in this association are in the Merrill and Hanford series.

The soils of this association are used mainly for irrigated crops. They are also used for limited grazing and for homesites and related uses.

3. *Tujunga-Soboba association*

Nearly level to moderately sloping, somewhat excessively drained and excessively drained, very deep soils on alluvial valley floors

Soils in this association are near Fontana, Etiwanda, Cucamonga, and Ontario. They formed in alluvium derived from granitic rock. Slopes range from 0 to 9 percent. Elevation ranges from 900 to 2,200 feet. The average annual rainfall is 12 to 16 inches, the mean annual temperature ranges from 61° to 65° F, and the frost-free season is 230 to 280 days. Vegetation consists mainly of annual grasses and forbs.

This association makes up about 41 percent of the survey area. Tujunga soils make up about 60 percent of the association; Soboba soils about 30 percent; and Psamments and Fluvents, frequently flooded, 10 percent.

Tujunga soils are somewhat excessively drained and have a surface layer of brown, slightly acid loamy sand that is gravelly in places. Below this is pale-brown, slightly acid coarse sand.

Soboba soils are excessively drained and have a surface layer of grayish-brown, slightly acid, stony or gravelly loamy sand. Below this is brown, slightly acid very stony loamy sand and very pale brown, neutral very stony sand.

The Psamments and Fluvents, frequently flooded, are in streambeds of the Santa Ana River and other large creeks and their tributaries.

The soils of this association are used mainly for irrigated crops. They also are used for dryland crops, limited grazing, and as a source of sand, gravel, and road fill.

4. *Delhi association*

Nearly level to strongly sloping, somewhat excessively drained, very deep soils on alluvial fans

Areas of this soil association are near Ontario International Airport, near Cucamonga Creek, and west of Bloomington. The soils formed in wind-reworked granitic alluvium. Slopes range from 0 to 15 percent. Elevation ranges from 800 to 1,400 feet. The average annual rainfall is 12 to 16 inches, the mean annual temperature is 61° to 65° F, and the frost-free season is 230 to 280 days. Vegetation is mainly annual grasses and forbs.

This association makes up about 7 percent of the survey area. Delhi soils make up about 85 percent of this association, and minor soils make up the remaining 15 percent.

Delhi soils have been reworked by wind action. Their surface layer is pale-brown, slightly acid fine sand. Below is pale-brown or light yellowish-brown, slightly acid sand.

Minor soils of this association are in the Tujunga and Hanford series.

The soils of this association are used mainly for irrigated crops.

5. *Ramona-Chualar-Sorrento association*

Nearly level to moderately sloping, well-drained, very deep soils on alluvial fans and terraces

Areas of this soil association are near Redlands and Yucaipa and south of Mentone. The soils formed in alluvium derived from granitic and sedimentary rocks. Slopes range from 0 to 9 percent. Elevation ranges from 600 to 3,000 feet. The average annual rainfall is 12 to 18 inches, the mean annual temperature ranges from 59° to 65° F, and the frost-free season is 230 to 300 days. Vegetation consists mainly of annual grasses and forbs, but chamise grows in some areas.

This association makes up about 6 percent of the survey area. Ramona soils make up about 70 percent of the association, Chualar soils about 20 percent, and Sorrento soils about 10 percent.

Ramona soils have a surface layer of brown, slightly acid sandy loam or fine sandy loam. Their subsoil is brown and yellowish-red, neutral loam and clay loam and reddish-yellow, neutral sandy clay loam. The underlying material is brownish-yellow, neutral sandy loam.

Chualar soils have a surface layer of dark grayish-brown, slightly acid clay loam. Their subsoil is dark grayish-brown, neutral to moderately alkaline clay loam. The underlying material is light-gray, moderately alkaline calcareous loam.

Sorrento soils have a thick surface layer of dark grayish-brown, neutral and mildly alkaline clay loam. Below this is brown, moderately alkaline clay loam that is calcareous in the lower part.

Minor soils in this association are in the Monserate and Greenfield series.

The soils of this association are used mainly for irrigated and dryland crops.

6. *Ramona association*

Strongly sloping to moderately steep, well-drained, very deep soils on terraces

Areas of this soil association are south of Yucaipa along the county line. The soils formed in alluvium derived from granitic rock. Slopes range from 9 to 30 percent. The elevation ranges from 1,400 to 3,000 feet. The average annual rainfall is 12 to 18 inches, the mean annual temperature ranges from 59° to 62° F, and the frost-free season is 230 to 290 days. Vegetation consists mainly of annual grasses and forbs.

This association makes up about 3 percent of the survey area. Ramona soils make up about 80 percent of the association, and minor soils make up 20 percent.

Ramona soils have a surface layer of brown, slightly acid sandy loam or fine sandy loam. Their subsoil is brown and yellowish-red, neutral loam and clay loam and reddish-yellow, neutral sandy clay loam. The substratum is brownish-yellow, neutral sandy loam. These soils are eroded in many places.

The minor soils in this association are in the Greenfield, Hanford, and Saugus series.

Most areas of this association are used for dryland small grain and pasture. Some small areas are used for citrus crops.

Soils of the Uplands

This region consists of upland foothills, mountains, and ridges. The areas are in the southern foothills of the San Gabriel and San Bernardino Mountains along the San Bernardino National Forest, the Chino Hills, and the Crafton Hills; and near Riverside County on Blue Mountain, the Jurupa Mountains, and the uplands near San Timoteo Wash. The soils formed in material weathered from granitic, sedimentary, and metamorphosed rock. Rocks crop out in many places.

Elevation in this region ranges from about 900 to 6,000 feet. The average annual rainfall is 10 to 25 inches. The vegetation consists mainly of annual grasses and forbs and some chamise or manzanita brush. There are a few scattered oak and pine trees and some perennial grasses. Growing seasons at higher elevations are apt to be somewhat shorter than those at lower elevations. The three soil associations in this upland area make up about 18 percent of the survey area.

7. *Cieneba-Tollhouse-Friant association*

Steep, excessively drained and somewhat excessively drained, shallow soils over schist and granite; on foothills and mountains

Areas of this soil association are along the southern foothills of the San Gabriel and San Bernardino Mountains, the Crafton Hills near Zanja and Pisgah Peaks, and in the vicinity of Blue Mountain. The soils formed in place in material weathered from granitic and mica schist. Most slopes range from 30 to 50 percent. Elevation ranges from 1,000 to 6,000 feet. The average annual rainfall is 12 to 25 inches, the mean annual temperature ranges from 61° to 65° F, and the frost-free season is 230 to 280 days. At higher elevations of about 4,000 to 6,000 feet, the mean annual temperature ranges from 52° to 57° F, and the frost-free season is 160 to 210 days. The vegetation is mainly annual grasses and forbs and scattered shrubs of chamise and manzanita. Some oak, pine, and perennial grasses grow at higher elevations.

This association makes up about 9 percent of the survey area. Cieneba soils make up about 70 percent of the association, Tollhouse soils about 20 percent, Friant soils 8 percent, and minor soils about 2 percent.

Cieneba soils are somewhat excessively drained and are slightly acid and neutral throughout. They have a surface layer of brown sandy loam. Below this is pale-brown sandy loam. Depth to weathered granitic rock is between 12 and 20 inches. Cieneba soils are closely intermingled with areas of Rock outcrop.

Tollhouse soils are excessively drained and are slightly acid throughout. They have a surface layer of dark grayish-brown and brown sandy loam. Below this is somewhat weathered granitic rock between depths of 10 and 20 inches.

Friant soils are somewhat excessively drained and are slightly acid or neutral throughout. They have a surface layer of dark-brown and brown fine sandy loam. This is underlain by hard mica schist at a depth

of 10 to 18 inches. Friant soils are intermingled with areas of Rock outcrop.

Minor soils in this association are in the Vista and Crafton series.

The soils of this association are used mainly for watershed purposes. They are sometimes used for range or pasture or for homesites.

8. Saugus-Fontana-Nacimiento association

Steep, well-drained, moderately deep to deep soils over sandstone and shale; on foothills

The soils of this association are in the foothills of the Chino Hills and Jurupa Mountains and in uplands near the San Timoteo Wash. They formed in place in material derived from sandstone and shale. Slopes range from 30 to 50 percent in most places. Elevation ranges from 800 to 2,500 feet. The average annual rainfall is 12 to 16 inches, the mean annual temperature ranges from 61° to 65° F, and the frost-free season is 230 to 290 days. Annual grasses, forbs, and some chamise and a few scattered oak trees make up plant cover.

This association covers 7 percent of the survey area. Saugus soils make up about 45 percent of the association, Fontana soils about 30 percent, Nacimiento soils 15 percent, and minor soils about 10 percent.

Saugus soils have a surface layer of brown neutral sandy loam. Below this is yellowish-brown sandy loam and loam. This is underlain by weakly consolidated loamy material at a depth of 40 to 50 inches.

Fontana soils have a surface layer of dark grayish-brown, slightly acid or mildly alkaline thick clay loam. Below this is yellowish-brown, moderately alkaline shaly clay loam. This is underlain by soft shale or sandstone at a depth of 22 to 38 inches.

Nacimiento soils are moderately alkaline and calcareous throughout. They have a surface layer of dark grayish-brown clay loam. This is underlain by light yellowish-brown, calcareous weathered sandstone or shale between depths of 26 and 40 inches.

Minor soils in this association are in the Alo, San Timoteo, and Soper series.

The soils of this association are used mainly for dryland pasture and watershed. Some areas are used for homesites.

9. Gaviota-Rock outcrop association

Steep, somewhat excessively drained, shallow soils over hard sandstone, and sandstone rock outcrops; on foothills

Areas of this soil association are in the foothills of the Chino Hills. The soils formed in place in material weathered from sandstone. Slopes range from 30 to 50 percent. Elevation ranges from 900 to 1,400 feet. The average annual rainfall is 10 to 16 inches, the mean annual temperature ranges from 62° to 65° F, and the frost-free season is 250 to 300 days. Annual grasses and forbs make up the plant cover.

This association makes up about 2 percent of the survey area. Gaviota soils make up about 60 percent of the association, Rock outcrop about 20 percent, and minor soils 20 percent.

Gaviota soils are slightly acid or neutral throughout. They have a surface layer of brown and light-brown fine sandy loam. This is underlain by hard sandstone between depths of 10 and 15 inches. Gaviota soils are intermingled with areas of Rock outcrop.

Minor soils in this association are in the Alo, Fontana, and Nacimiento series.

The soils of this association are used mainly for dryland pasture and watershed.

Descriptions of the Soils

In this section the soils of San Bernardino County, Southwestern Part, are described in detail and their use and management are discussed. Each soil series is described in detail, and then, briefly, the mapping units in that series. Unless it is specially mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for dry soil unless otherwise stated. The profile described in the soil series is representative for mapping units in that series. If a given mapping unit has a profile in some ways different from the one described in the series, these differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Psamments and Fluvents, frequently flooded, for example, do not belong to a soil series, but nevertheless are listed in alphabetical order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page for the description of the capability unit can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*17*)[1].

[1] Italic numbers in parentheses refer to Literature Cited, p 62.

TABLE 1. — *Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Alo clay, 30 to 50 percent slopes	1,080	0.4
Chino silt loam	6,630	2.2
Chualar clay loam, 0 to 2 percent slopes	905	.3
Chualar clay loam, 2 to 9 percent slopes	2,645	.9
Chualar clay loam, 9 to 15 percent slopes	1,055	.4
Cieneba sandy loam, 9 to 15 percent slopes	545	.2
Cieneba-Friant sandy loams	1,060	.4
Cieneba-Rock outcrop complex	14,790	5.0
Crafton-Rock outcrop complex, eroded	550	.2
Delhi fine sand	20,440	6.9
Fontana clay loam, 15 to 30 percent slopes	1,755	.6
Fontana clay loam, 30 to 50 percent slopes	6,800	2.3
Friant-Rock outcrop complex	2,270	.8
Garretson very fine sandy loam, 2 to 9 percent slopes	500	.2
Gaviota-Rock outcrop complex	4,720	1.6
Grangeville fine sandy loam	7,510	2.5
Grangeville fine sandy loam, saline-alkali	1,350	.5
Greenfield sandy loam, 2 to 9 percent slopes	8,010	2.7
Greenfield sandy loam, 9 to 15 percent slopes	525	.2
Greenfield cobbly sandy loam, 5 to 15 percent slopes	220	(1)
Hanford coarse sandy loam, 2 to 9 percent slopes	27,655	9.3
Hanford coarse sandy loam, 9 to 15 percent slopes	1,655	.6
Hanford sandy loam, 0 to 2 percent slopes	6,615	2.2
Hilmar loamy fine sand	4,135	1.4
Merrill silt loam	1,155	.4
Metz coarse sandy loam, 2 to 9 percent slopes	300	.1
Monserate sandy loam, 2 to 9 percent slopes	640	.2
Nacimiento clay loam, 9 to 30 percent slopes	1,270	4
Nacimiento clay loam, 30 to 50 percent slopes	3,030	1.0
Oak Glen sandy loam, 2 to 9 percent slopes	540	.2
Oak Glen gravelly sandy loam, 9 to 15 percent slopes	1,060	.4
Oak Glen gravelly sandy loam, 15 to 30 percent slopes	670	.2
Psamments and Fluvents, frequently flooded	8,800	3.0
Ramona sandy loam, 2 to 9 percent slopes	8,040	2 7
Ramona sandy loam, 9 to 15 percent slopes	3,310	1.1
Ramona sandy loam, 15 to 30 percent slopes, eroded	3,180	1.1
San Emigdio sandy loam, 9 to 15 percent slopes	370	.1
San Emigdio gravelly sandy loam, 2 to 9 percent slopes	470	.2
San Emigdio fine sandy loam, 0 to 2 percent slopes	1,900	6
San Emigdio fine sandy loam, 2 to 9 percent slopes	3,145	1.1
San Timoteo loam, 30 to 50 percent slopes, eroded	2,430	.8
Saugus sandy loam, 30 to 50 percent slopes	9,455	3.2
Soboba gravelly loamy sand, 0 to 9 percent slopes	11,740	3.9
Soboba stony loamy sand, 2 to 9 percent slopes	23,225	7.8
Soper gravelly loam, 15 to 30 percent slopes	380	.1
Soper gravelly loam, 30 to 50 percent slopes	550	.2
Sorrento clay loam, 0 to 2 percent slopes	1,680	.6
Sorrento clay loam, 2 to 5 percent slopes	305	.1
Tollhouse sandy loam, 30 to 50 percent slopes	4,460	1.5
Tujunga loamy sand, 0 to 5 percent slopes	42,930	14.4
Tujunga gravelly loamy sand, 0 to 9 percent slopes	36,720	12.3
Vista-Rock outcrop complex	1,020	.3
Quarries and gravel pits	685	.2
Total	296,880	100.0

[1] Less than 0.1 percent.

The detailed map in this publication and the one in the published soil survey of the Western Riverside Area do not always aline where mapping units join along the Riverside County line. The main reason for this is that in many places areas that would be mapped as separate soils are too small (2-5 acres) to justify setting up a new series or mapping unit and are therefore treated as inclusions. In other places similar areas may not match because soils do not always change abruptly and transitional areas are present. Other reasons for differences between the two adjoining maps are that map scales are not the same and intensity in detail of mapping varies. Also, during the time that has elapsed between the publication of the two soil surveys some concepts of classification have changed.

Alo Series

The Alo series consists of well-drained, steep soils that formed on uplands in material weathered from shale and fine-grained sandstone. Slopes are 30 to 50 percent. Elevation is 900 to 1,300 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 250 to 310 days.

In a representative profile, the surface layer is dark grayish-brown clay about 20 inches thick. The next layer is dark grayish-brown clay about 16 inches thick. The underlying material is light olive-brown weathered shale of clay texture to a depth of 60 inches. The surface layer is slightly acid in the upper part and neutral in the lower part. The soil is calcareous below the surface layer. It is moderately alkaline to a depth of 36 inches and strongly alkaline below that depth.

These soils are slowly permeable. Their available water capacity is 4 to 6 inches. Roots can penetrate to a depth of 24 to 36 inches.

These soils are used for pasture and as watershed.

Representative profile of Alo clay, 30 to 50 percent slopes, about 50 feet west of farm road; SW¼SW¼ NE¼ sec. 9, T. 3 S., R. 8 W.; San Bernardino base line and meridian:

A11—0 to 13 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; strong, medium, subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; common, very fine, tubular pores; many vertical cracks about 1 inch wide that extend throughout; slightly acid; diffuse, wavy boundary.

A12—13 to 20 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; very hard, firm, sticky and plastic; common very fine roots; common, very fine, tubular pores; many intersecting slickensides; many vertical cracks about 1 inch wide that extend throughout horizon; neutral; clear, wavy boundary.

AC—20 to 36 inches, mixed dark grayish-brown (10YR 4/2) and about 10 percent grayish-brown (2.5YR 5/2) clay, very dark grayish brown (10YR 3/2) and about 10 percent dark grayish brown (2.5Y 4/2) when moist; moderate, medium, subangular blocky

structure; very hard, firm, sticky and plastic; few very fine roots; few, very fine, tubular pores; few vertical cracks ⅜ to ½ inch wide that extend to a depth of 30 inches; many intersecting slickensides; slightly effervescent; segregated lime in soft masses; moderately alkaline; abrupt, smooth boundary.

C—36 to 60 inches, light olive-brown (2.5Y 5/4) weathered shale of clay texture, olive brown (2.5Y 4/4) when moist; strongly effervescent; some segregated lime in soft masses; strongly alkaline.

The A horizon is generally dark grayish brown or grayish brown, but in a few places it is brown. Its texture is mainly clay; it is heavy clay loam in places. Structure is strong or moderate, medium or coarse, subangular blocky to angular blocky. Reaction is generally medium acid to neutral; it is mildly alkaline in a few places. After long dry periods large cracks, ½ to 1 inch wide, extend to a depth of 24 to 30 inches. Few to many wedge-shaped aggregates and slickenside faces are in the lower part of the A horizon and in the AC horizon. The gilgai microrelief is poorly developed. Depth to the underlying shale ranges from 24 to 36 inches.

Alo clay, 30 to 50 percent slopes (AaF).—This steep soil is on foothills. Included with it in mapping are small areas of Fontana clay loam and other areas up to 10 to 20 acres in size where slopes are 20 to 25 percent. Also included are small patches of Nacimiento clay loam, a few landslips, and small areas of rock fragments.

Runoff is rapid after the soil is wet, and the hazard of erosion is moderate.

This soil is used for seeded dryfarmed pasture, grazing in spring, and watershed. Capability unit VIe-1 dryland.

Chino Series

The Chino series consists of somewhat poorly drained, nearly level soils. These soils formed on flood plains and in basins in moderately fine textured alluvium. Slopes are 0 to 2 percent. Elevation is 700 to 750 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 250 to 310 days.

In a representative profile, the surface layer is gray silt loam about 16 inches thick. The underlying material is gray light silty clay loam and silty clay loam that extends to a depth of 60 inches or more. It has a few mottles. Chino soils are moderately alkaline and strongly calcareous throughout.

These soils are moderately slowly permeable. Their available water capacity is about 10 to 12 inches. Roots can penetrate to a depth of 60 inches or more. Although this soil is somewhat poorly drained, the drainage has been altered by pumping irrigation water and lowering the water table. Thus, wetness is not a concern.

These soils are used for irrigated alfalfa, grains, corn silage, and pasture plants. Small areas are used for homesites and related uses.

Representative profile of Chino silt loam, about 100 feet north of Kimball Avenue and about 100 feet east of Euclid Avenue; NE¼SE¼SE¼ sec. 30, T. 2 S., R. 7 W.; San Bernardino base line and meridian:

Ap—0 to 8 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine and fine, tubular pores; strongly effervescent; moderately alkaline; gradual, smooth boundary.

A12—8 to 16 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine and fine, tubular pores; strongly effervescent; moderately alkaline; clear, wavy boundary.

C1—16 to 38 inches, gray (5Y 5/1) light silty clay loam, dark gray (5Y 4/1) when moist; few, fine, distinct, olive-brown (5Y 6/6) mottles, olive (5Y 4/4) when moist; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine roots; common, very fine and fine, tubular pores; strongly effervescent; moderately alkaline; clear, wavy boundary.

C2—38 to 60 inches, gray (5Y 5/1) silty clay loam, dark gray (5Y 4/1) when moist; few, fine, distinct, olive-brown (5Y 6/6) mottles; olive (5Y 5/6) when moist; weak, medium, angular blocky structure; hard, firm, sticky and plastic; few fine and very fine roots; common, very fine and fine, tubular pores; strongly effervescent; moderately alkaline.

The A horizon is generally gray but ranges to grayish brown. Its texture is very fine sandy loam or silt loam. Structure is generally weak or moderate, fine, granular in the upper part of the A horizon and moderate, medium, subangular blocky in the lower part. In places, however, it is weak or moderate, fine or medium, subangular blocky throughout. Effervescence is generally strong, but in a few places it is slight in the upper part of the A horizon. The A horizon ranges from 12 to 18 inches in thickness but is about 16 inches thick in most places.

The C horizon is generally gray; in a few places it is grayish brown or olive gray. Its texture generally is light silty clay loam or silty clay loam; it is clay loam in places. Mottles vary from few to common, are fine to medium in size, and are typically distinct in contrast in colors of olive, olive brown, or dark olive gray. In places the lower part of the C horizon contains segregated lime in the form of soft masses, fine concretions, or filaments. Structure is weak or moderate, fine to coarse, angular or subangular blocky.

In this survey area Chino soils tend to have bright, distinct mottles higher in the profile than is within the defined range for the series. This difference does not alter their usefulness and behavior.

Chino silt loam (Cb).—This nearly level soil is in broad, smooth areas on alluvial valley bottoms and in basins. Included with it in mapping are small areas of Merrill silt loam.

Runoff is slow or very slow. The hazard of erosion is slight. The soil may be ponded for short periods during long winter rains.

This Chino soil is used for irrigated crops, such as corn silage, alfalfa, grains, and pasture plants. Small areas are used for homesites. Capability unit I irrigated.

Chualar Series

The Chualar series consists of well-drained, nearly level to strongly sloping soils. These soils formed on alluvial fans and terraces in mixed, moderately fine textured alluvium. Slopes are 0 to 15 percent. Elevation is 600 to 1,100 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to

16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 300 days.

In a representative profile, the surface layer is dark grayish-brown clay loam about 11 inches thick. The subsoil is dark grayish-brown clay loam about 25 inches thick. The underlying material is light-gray loam that extends to a depth of more than 60 inches. Chualar soils are slightly acid in the surface layer. They are less acid with increasing depth and are moderately alkaline in the underlying material. They are calcareous below a depth of about 31 inches.

These soils are moderately slowly permeable. Their available water capacity is about 9 to 11 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for irrigated small grains, pasture plants, alfalfa, and silage. Some areas are used for dryfarmed small grains and pasture plants.

Representative profile of Chualar clay loam, 0 to 2 percent slopes, about three-fourths of a mile south of Pine Avenue at the south end of Johnson Road on Van Vliet's farm southwest of farm pond; NW¼NW¼ NW¼ sec. 5, T. 3 S., R. 7 W.; San Bernardino base line and meridian:

A1—0 to 11 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine and fine roots; common, very fine and fine, tubular pores; slightly acid; clear, wavy boundary.

B1t—11 to 19 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and coarse, angular blocky structure; hard, firm, sticky and plastic; common very fine and few fine roots; common, very fine and fine, tubular pores; few thin clay films on ped faces and lining tubular pores; neutral; clear, wavy boundary.

B21t—19 to 31 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and coarse, angular blocky structure; hard, firm, sticky and plastic; common very fine roots; common, very fine and fine, tubular pores; common moderately thick clay films on ped faces and lining tubular pores; mildly alkaline; clear, wavy boundary.

B22t—31 to 36 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and coarse, angular blocky structure; hard, firm, sticky and plastic; common, very fine, exped roots; common, very fine, tubular pores; common moderately thick clay films on ped faces and lining tubular pores; moderately alkaline; strongly effervescent; clear, wavy boundary.

C1—36 to 59 inches, light-gray (2.5Y 7/2) loam, light grayish brown (2.5Y 6/2) when moist; moderate, medium, angular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; common, very fine, tubular pores; common moderately thick clay films on ped faces and lining tubular pores; strongly effervescent; moderately alkaline; clear, wavy boundary.

C2—59 to 67 inches, light-gray (5Y 7/2) loam, light olive gray (5Y 6/2) when moist; strong, coarse, angular blocky structure; hard, firm, slightly sticky and slightly plastic; few, very fine, tubular pores; strongly effervescent with lime coatings on ped faces; moderately alkaline.

The A horizon is typically dark grayish brown; in a few places it is grayish brown. Its texture is clay loam or loam. Structure is weak or moderate, fine or medium, angular or subangular blocky. Thickness is generally about 11 inches but ranges from 8 to nearly 18 inches in places.

The Bt horizon is generally dark grayish brown; in places it is brown. Structure is weak or moderate, medium or coarse, subangular or angular blocky. In a few places weak prisms occur that readily part to blocky structure. Clay films are few or common and are thick to thin. They infrequently occur as bridgings. Thickness is commonly about 25 inches but ranges from 20 to 28 inches. The lower part of the Bt horizon is slightly to strongly effervescent.

The C horizon is generally light gray, light brownish gray, or grayish brown; in places it is pale brown or brown. In most places it is loam, but in some places texture is sandy loam or clay loam. Structure ranges from moderate, medium, angular or subangular blocky to strong, coarse, angular blocky. In places the C horizon is massive. Reaction ranges from moderately alkaline to strongly alkaline.

Chualar clay loam, 0 to 2 percent slopes (CkA).—This nearly level soil occupies alluvial fans and terraces. It has the profile described as representative of the series. Included with it in mapping are small scattered areas, 5 to 10 acres in size, of Sorrento clay loam and Chino silt loam. Also included are areas, up to 10 acres in extent, where slopes are 2 or 3 percent.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated small grains, alfalfa, pasture plants, and silage crops. Small areas are used for homesites and related uses. Capability unit I irrigated.

Chualar clay loam, 2 to 9 percent slopes (CkC).—This gently sloping to moderately sloping soil is on alluvial fans and terraces. The soil has a profile similar to the one described as representative of the series, but in a few small areas loamy coarse sand and gravel lenses are 50 and 60 inches below the surface or deeper. Included in mapping are small areas of Sorrento clay loam and Garretson very fine sandy loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate where the soil is tilled and left exposed.

This soil is used for irrigated small grains, pasture plants, alfalfa, and dryfarmed pasture. Capability unit IIe-1 irrigated.

Chualar clay loam, 9 to 15 percent slopes (CkD).—This strongly sloping soil occurs as small scattered bodies on alluvial fans and high terraces. This soil has a profile similar to the one described as representative of the series, but the underlying material of this soil is only slightly calcareous. Included in mapping are small areas of a soil that has moderate sheet and rill erosion; in these areas the surface layer averages 8 to 10 inches thick. Also included are patches of Ramona sandy loam, 9 to 15 percent slopes, and small areas of Garretson very fine sandy loam, 2 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate to high.

This soil is used for dryfarmed pasture and small grains. Capability unit IIIe-1 irrigated.

Cieneba Series

The Cieneba series consists of somewhat excessively drained, strongly sloping to steep soils. These soils

formed on uplands in material weathered from granitic rock. Slopes are 9 to 50 percent. Elevation is 1,000 to 2,000 feet. Vegetation is chaparral, chamise, and annual grasses and forbs. The average annual precipitaion is 15 to 18 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is brown, slightly acid sandy loam about 8 inches thick. The underlying material is pale-brown, neutral sandy loam about 6 inches thick that overlies reddish-yellow, weathered granitic rock.

These soils are rapidly permeable. Their available water capacity is about 1 to 3 inches. Roots can penetrate to a depth of 12 to 20 inches.

These soils are used mainly for range and watershed. Small areas are used for dryfarmed small grain and for homesites.

Representative profile of Cieneba sandy loam, 30 to 50 percent slopes, in an area of Cieneba-Rock outcrop complex, about 50 feet south of North Sunset Drive; NW¼SE¼SE¼ sec. 6, T. 2 S., R. 2 W.; San Bernardino base line and meridian:

A1—0 to 8 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; gradual, smooth boundary.

C1—8 to 14 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many, very fine, interstitial and tubular pores; about 5 to 10 percent weathered granitic gravel; 2 to 4 millimeters in size; neutral; clear, smooth boundary.

C2—14 to 60 inches, reddish-yellow (7.5YR 7/6) weathered granitic bedrock, strong brown (7.5YR 5/6) when moist.

The A horizon is brown or pale brown. Texture is sandy loam or coarse sandy loam but is loam in a few places. Structure is typically weak or moderate, fine or medium, granular; it ranges to subangular blocky. Thickness ranges from 8 to 12 inches but is about 8 inches in most places.

The C1 horizon is pale brown or very pale brown. Structure is generally subangular or angular blocky, but in some places the C1 horizon is massive. Thickness ranges from 4 to 8 inches.

The C2 horizon is typically reddish yellow but in places is strong brown or yellowish brown. The weathered granitic bedrock can be augered or cut with handtools.

Cieneba sandy loam, 9 to 15 percent slopes (CnD). —This strongly sloping soil is in small areas on foothills throughout the uplands. Included with it in mapping are a few rock outcrops and small patches of soils that have moderate sheet and rill erosion.

Runoff is medium and the hazard of erosion is moderate if the soil is protected or not overgrazed. If this soil is left bare, burned over, or exposed during engineering construction, the hazard of erosion can be high.

This soil is used mainly for dryfarmed grains and pasture. Some areas are used for homesites and other community uses. Capability unit IVe-1 dryland.

Cieneba-Friant sandy loams (Cp). —This steep complex occupies uplands. It is about 60 percent Cieneba sandy loam, 30 to 50 percent slopes, and 35 percent Friant sandy loam, 30 to 50 percent slopes. The Cieneba soil occupies slightly concave side slopes but also occurs on rounded ridgetops. The Friant soil is generally on ridgetops and on the upper part of north-facing slopes.

Included with this complex in mapping are small areas, 5 to 20 acres in size, of Ramona sandy loam, 9 to 15 percent slopes, on terraces. Also included are small patches of soils that have moderate sheet and rill erosion. Rock outcrops occur throughout the area, occupying 5 percent of the area.

Runoff is rapid, and the hazard of erosion is moderate if the soils are not left bare. The hazard of erosion is high if the soils are left bare and unprotected.

The soils in this complex are used for watershed and grazing during the spring. Capability unit VIIe-1 dryland.

Cieneba-Rock outcrop complex (Cr). —This steep complex occupies areas on uplands. It is about 60 percent Cieneba sandy loam, 30 to 50 percent slopes, and 30 percent granitic rock outcrops. The Cieneba soil occurs at random throughout each mapped area, but rock outcrops are generally along the ridgetops and north-facing slopes. The Cieneba soil has the profile described as representative of the series.

Included with this complex in mapping are small areas of soils that have moderate sheet and rill erosion, places where slopes exceed 50 percent, and small areas where slopes are 15 to 25 percent. Also included are small areas that consist mainly of Rock outcrop.

Runoff is rapid, and the hazard of erosion is moderate if soils are burned over or overgrazed.

This complex is used chiefly for grazing during spring and for watershed. Capability unit VIIe-1 dryland.

Crafton Series

The Crafton series consists of well-drained, steep soils. These soils formed on uplands in material weathered from micaceous schist. Slopes are 30 to 50 percent. Elevation is 3,500 to 4,500 feet. Vegetation is chamise, chaparral, live oak, and annual grasses and forbs. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is 52° to 57° F, and the frost-free season is 160 to 300 days.

In a representative profile, the surface layer is dark-brown sandy loam about 10 inches thick. The underlying material is yellowish-brown sandy loam about 16 inches thick. It overlies pale-brown weathered micaceous schist. Crafton soils are medium acid to slightly acid throughout the profile.

These soils are moderately rapidly permeable. Their available water capability is 2 to 4 inches. Roots can penetrate to a depth of 20 to 36 inches.

These soils are used for range in spring and for watershed.

Representative profile of Crafton sandy loam, 30 to 50 percent slopes, in an area of Crafton-Rock outcrop

complex, eroded, about 400 feet south of Wildwood Canyon Road about one-fourth mile west of Oak Glen Road; SE¼SW¼SW¼ sec. 10, T. 3 S., R. 8 W.; San Bernardino base line and meridian.

A11—0 to 2 inches, dark-brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine crumb structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine pores; medium acid; gradual, smooth boundary.

A12—2 to 10 inches, dark-brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine crumb structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine pores; many mica flakes; slightly acid; gradual, smooth boundary.

C1—10 to 26 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; very fine and medium roots; many fine mica flakes; slightly acid; clear, wavy boundary.

C2—26 to 40 inches, pale-brown (10YR 6/3) weathered micaceous schist, brown (10YR 5/3) when moist; few very fine and fine roots, mainly along fracture joints.

The A1 horizon is typically dark brown; it is dark grayish brown or dark yellowish brown in minor areas. This horizon is sandy loam or fine sandy loam that is largely mica. Structure ranges from weak, fine, crumb to weak, fine or medium, granular or subangular blocky. Thickness of the A horizon ranges from 6 to 12 inches.

The C1 horizon is yellowish brown to dark yellowish brown. Its texture is sandy loam or fine sandy loam in most places. It is, by volume, 5 to 15 percent weathered schist fragments. The horizon ranges in thickness from 14 to 28 inches. Reaction is generally slightly acid, but it is neutral in places.

The C2 horizon is pale brown, brown, or yellowish brown. The degree of weathering varies widely in depth and from place to place, but the soil can be dug or cut with hand-tools in most places. Hard schist generally is at depths below 60 inches. Depth to the C2 horizon ranges from 20 to 36 inches.

Crafton-Rock outcrop complex, eroded (Cs2).—This steep complex is on foothills in uplands. It is about 60 percent Crafton sandy loam, 30 to 50 percent slopes, and 30 percent Rock outcrop. Crafton soils generally occur at random throughout each mapped area but mostly on hillsides. Rock outcrop is along the ridgetops. The surface layer is 8 inches thick in most places. Sheet and rill erosion are moderate.

Included with this complex in mapping are areas of Cieneba sandy loam, 9 to 15 percent slopes, that make up about 10 percent of the total area.

Runoff is rapid, and the hazard of erosion is moderate to high where the soil is left bare because of fire or overgrazing.

The soil in this complex is used mainly for grazing during spring and for watershed. Capability unit VIIe-1 dryland.

Delhi Series

The Delhi series consists of somewhat excessively drained, nearly level to strongly sloping soils that formed on alluvial fans in coarse-textured, wind-reworked granitic material. Slopes are 0 to 15 percent. Elevation is 800 to 1,400 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the soil is pale-brown and light yellowish-brown fine sand and sand to a depth of more than 60 inches. Delhi soils are slightly acid throughout the profile.

These soils are rapidly permeable. Their available water capacity is about 4 to 5 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for grapes, alfalfa, pasture plants, and some citrus. They are commonly used as a source of construction materials.

Representative profile of Delhi fine sand about one-half mile south of Highway 60 and about 400 feet west of Millikan Avenue; NE¼SE¼ sec. 1, T. 2 S., R. 7 W.; San Bernardino base line and meridian:

C1—0 to 18 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; common very fine and fine roots; slightly acid; gradual, smooth boundary.

C2—18 to 40 inches, pale-brown (10YR 6/3) sand, brown (10YR 5/3) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; few very fine and fine roots; slightly acid; gradual, wavy boundary.

C3—40 to 60 inches, light yellowish-brown (10YR 6/4) sand, yellowish brown (10YR 5/4) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; slightly acid.

The C1 horizon, or Ap horizon where present, is pale brown, brown, or light brownish gray. Thickness ranges from 12 to 18 inches. Texture is fine sand or loamy fine sand. The soil material is generally single grained, but it has weak, thin or medium, platy structure in places. Reaction is generally slightly acid; it is medium acid or neutral in a few spots.

The C2 and C3 horizons are light yellowish-brown, pale-brown, very pale brown, or brownish-yellow sand, fine sand, or loamy sand. The soil material is generally single grained, but in some places it is massive. Reaction ranges from slightly acid to mildly alkaline. The C3 horizon is slightly calcareous in a few places.

Delhi fine sand (Db).—This nearly level to strongly sloping soil is on alluvial fans that have been reworked by wind action. About 5,700 acres of this soil, along Pepper Street west of Colton, is moderately to strongly sloping and is on fans. In these areas there are wind-deposited hummocks that are about 18 to 36 inches high.

Included with this soil in mapping are small areas of Tujunga loamy sand, 0 to 5 percent slopes. Also included are about 25 acres, one-fourth mile west of Millikan Avenue and 200 feet north of Riverside Drive, where a horizon of loam that is weakly cemented with lime is between depths of 18 and 28 inches.

Runoff is very slow, and the hazard of soil blowing is generally moderate. In unprotected areas, however, the hazard of soil blowing is high.

The Delhi soil is used mainly for grapes, pasture plants, alfalfa, and some citrus. It is also used as a source for sand and road fill. Capability unit IIIe-4 irrigated.

Fontana Series

The Fontana series consists of well-drained, moderately steep to steep soils that formed on rounded foothills in material derived from calcareous weathered shale and fine-grained sandstone. Slopes are 15 to 50 percent. Elevation is 900 to 1,600 feet. Vegetation is annual grasses and forbs and some scrub oak along drainageways. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 290 days.

In a representative profile, the surface layer is dark grayish-brown clay loam about 21 inches thick. The next layer is yellowish-brown shaly clay loam about 7 inches thick. The underlying material is weathered and fractured, platy, calcareous shale to a depth of 60 inches. Fontana soils are slightly acid in the upper 10 inches and mildly alkaline or moderately alkaline in the lower part.

These soils are moderately slowly permeable. Their available water capacity is 4 to 7.5 inches. Roots can penetrate to a depth of 22 to 38 inches.

These soils are used for dryfarmed small grains, pasture plants, range, and watershed. Some areas are used for homesites.

Representative profile of Fontana clay loam, 30 to 50 percent slopes, about 1¼ miles northwest of junction of Carbon Canyon Road and entrance to Western Hills Golf Course; NW¼SW¼ sec. 19, T. 2 S., R. 8 W.; San Bernardino base line and meridian:

A11—0 to 10 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine, common fine, and very few medium roots; common, very fine, interstitial pores and few, fine tubular pores; slightly acid; clear, smooth boundary.

A12 10 to 21 inches, dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when very friable, nonsticky and nonplastic; many very moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine and fine roots; many, very fine, interstitial pores and common, fine, tubular pores; about 10 percent soft, weathered, yellow (10YR 7/6) shale fragments, ¼ to ½ inch in diameter; slightly effervescent; mildly alkaline; clear, wavy boundary.

C1ca—21 to 28 inches, yellowish-brown (10YR 5/4) shaly clay loam, dark yellowish brown (10YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine and few fine roots; common, very fine, interstitial pores and common, fine, tubular pores; about 25 percent weathered yellow (10YR 7/6) shale fragments, ½ to 1 inch in diameter; strongly effervescent; common, soft, powdery threads and few, small, soft concretions; coatings on shale fragments; moderately alkaline; abrupt, wavy boundary.

C2—28 to 60 inches, yellow (10YR 7/6), weathered and fractured, platy shale; easy to dig or cut with handtools; strongly calcareous; moderately alkaline.

The A1 horizon is dark grayish brown, grayish brown, or brown. Its texture is clay loam or silty clay loam. Structure is typically very fine to medium, moderate or strong, subangular blocky. This horizon is slightly acid in the upper 10 inches and mild to moderately alkaline below. Effervescence in the lower part of the A1 horizon ranges from slight to moderate. This horizon is noncalcareous in the surface layer except where rodents have mixed the soil material. Thickness ranges from 20 to 30 inches but is typically 20 to 24 inches. When the soil dries, cracks that are ⅜ to ½ inch wide form and extend to a depth of 16 to 18 inches. Small pressure faces occur in many places. In some places, the lower part of the A1 horizon lacks weathered shale fragments, and in some places a calcareous A13 horizon is immediately above the weathered shale.

The C1ca horizon is yellowish brown, brown, or dark yellowish brown. Typically it is moderately alkaline and strongly calcareous. Weathered shale fragments range from 5 to 30 percent and vary in size from ⅜ to 1 inch. Depth to weathered bedrock is 22 to 38 inches.

Fontana clay loam, 15 to 30 percent slopes (FoE). — This moderately steep soil is on rounded, often hilly uplands. Shale bedrock crops out on about 1 percent of the surface area.

Included with this soil in mapping are areas of Alo clay, 30 to 50 percent slopes, that make up about 5 percent of the area. Also included are areas of Nacimiento clay loam, 9 to 30 percent slopes, and a few small areas where cattle have trampled the surface and left it hard or very hard.

Runoff is medium, and the hazard of erosion is slight to moderate where the soil is protected.

This soil is used mainly for pasture, for spring grazing of livestock, and for watershed. A few areas where the soil has 15 to 20 percent slopes are used for dryfarmed small grains. Some areas are used for homesites. Capability unit IVe-1 dryland.

Fontana clay loam, 30 to 50 percent slopes (FoF). — This steep soil is on rounded foothills. It has the profile described as representative of the series. Shale crops out on about 1 percent of the surface area.

Included with this soil in mapping are areas, about 10 to 30 acres in size, where slopes are 20 to 25 percent. Also included are a few minor areas where slopes are as steep as 60 percent, areas where moderate sheet and rill erosion occur at the heads of draws, areas where a few shallow gullies cut the surface, and small patches of Alo soils. Also included are a few small areas, mainly on southern exposures, where the surface is hard or very hard as a result of trampling by cattle.

Runoff is rapid, and the hazard of erosion is moderate.

This soil is used mainly for livestock grazing in spring and for watershed. Some areas are used for homesites. Capability unit VIe-1 dryland.

Friant Series

The Friant series consists of somewhat excessively drained, steep soils. These soils formed on uplands in material weathered from mica schist. Slopes are 30 to 50 percent. Elevation is 1,000 to 3,000 feet. Vegetation is big sagebrush, chamise, and annual forbs and grasses. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is dark-brown and slightly acid and brown and neutral fine

sandy loam about 15 inches thick. The underlying material is slightly weathered, hard mica schist.

These soils are moderately rapidly permeable. Their available water capacity is about 1 to 2 inches. Roots can penetrate to a depth of 10 to 18 inches.

These soils are used for spring grazing of livestock and for watershed.

Representative profile of Friant fine sandy loam, 30 to 50 percent slopes, in an area of Friant-Rock outcrop complex, about 200 feet northeast of Crafton Reservoir on Reservoir Road about a mile south of Mentone; NE¼NE¼SW¼ sec. 29, T. 1 S., R. 2 W.; San Bernardino base line and meridian:

A11—0 to 5 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial and tubular pores; slightly acid; clear, smooth boundary.

A12—5 to 14 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; neutral; abrupt, wavy boundary.

R—14 inches, yellowish-brown (10YR 5/4), hard mica schist, dark yellowish brown (10YR 4/4) when moist.

The A1 horizon is dark brown, brown, or dark grayish brown. Its texture is sandy loam or fine sandy loam. Structure is weak, fine, granular or in a few instances weak, subangular blocky. Reaction is typically slightly acid in the upper part of the A horizon and neutral in the lower part. In places it is medium acid at the surface. Thickness is generally 14 inches but ranges from 10 to 16 inches.

Generally the A horizon overlies the schistose parent rock, but in a few places there is a very thin C horizon consisting of sandy loam that contains schist fragments. In places this horizon is as thick as 6 inches. Depth to bedrock ranges from 10 to 18 inches.

Friant-Rock outcrop complex (Fr).—This steep complex occupies foothills in the uplands. It is about 55 percent Friant fine sandy loam, 30 to 50 percent slopes, and 30 percent Rock outcrop. The Friant soils and Rock outcrop occur at random throughout each mapped area, but Rock outcrop is generally along the ridgetops. The Friant soil has the profile described as representative of the series.

Included with this complex in mapping are small areas of Cieneba sandy loam, 9 to 15 percent slopes. Also included are areas of Vista sandy loam. Slopes are generally 30 to 50 percent, but in some places they are more than 50 percent or less than 30 percent but not less than 15 percent. Runoff is rapid, and the hazard of erosion is moderate. If soils are left bare because of fire or overgrazing, the hazard of erosion is high.

The Friant soil is used for grazing of livestock and for watershed. Capability unit VIIe-1 dryland.

Garretson Series

The Garretson series consists of well-drained, gently sloping to moderately sloping soils. These soils formed on alluvial fans in alluvium derived from mixed but largely sandstone sources. Slopes are 2 to 9 percent. Elevation is 600 to 800 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is grayish-brown very fine sandy loam and loam about 28 inches thick. The underlying material, to a depth of 60 inches, is 6 inches of brown fine sandy loam, 8 inches of brown gravelly sandy loam, and 18 inches of brown loam. The upper 7 inches of the surface layer is neutral. Below this the soil material is mainly moderately alkaline. Below a depth of 34 inches it is slightly calcareous and contains some lime in soft masses.

These soils are moderately permeable. Their available water capacity is about 8 to 10 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used mainly for irrigated small grains and pasture plants.

Representative profile of Garretson very fine sandy loam, 2 to 9 percent slopes, about one-fourth mile east of Highway 71, about 100 feet west of Pomona-Rincon Road, and about 75 feet north of San Bernardino-Riverside County Line; NE¼SW¼SE¼ sec. 7, T. 3 S., R. 7 W.; San Bernardino base line and meridian:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) very fine sandy loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine and fine, tubular and interstitial pores; neutral; clear, smooth boundary.

A12—7 to 28 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) when moist; moderate, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many medium, very fine, and fine pores; moderately alkaline; gradual, wavy boundary.

C1—28 to 34 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; massive; hard, very friable, nonsticky and nonplastic; common very fine and fine roots; many medium, very fine and fine, tubular pores; mildly alkaline; abrupt, wavy boundary.

IIC2—34 to 42 inches, brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) when moist; massive; hard, very friable, nonsticky and slightly plastic; common very fine and fine roots; many, very fine and fine, tubular pores; slightly effervescent; some lime occurring in soft masses; moderately alkaline; abrupt, smooth boundary.

IIIC3—42 to 60 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine and fine, tubular pores; slightly effervescent; some lime in the form of soft masses; moderately alkaline.

The A1 horizon generally is grayish brown, brown, or yellowish brown. Structure ranges from weak to moderate, fine to medium, subangular blocky to weak, fine, granular. Reaction is generally neutral to mildly alkaline in the upper part and moderately alkaline below. In places, however, it ranges between neutral and moderately alkaline throughout. The A1 horizon is estimated to be less than 1 percent organic matter. Thickness ranges from 20 to 28 inches.

The C horizon is typically brown, grayish brown, yellowish brown, or light yellowish brown. It is mainly loam but in places is fine sandy loam or gravelly fine sandy loam. In many places it contains thin, discontinuous lenses of sandy loam or gravelly sandy loam. The C horizon

is generally massive. In some instances, however, structure is weak, fine, subangular blocky. Reaction is mildly alkaline to moderately alkaline.

Garretson very fine sandy loam, 2 to 9 percent slopes (GaC). —This gently sloping to moderately sloping soil is on alluvial fans. Included with it in mapping are small patches, 5 to 10 acres in size, of a soil that has a surface layer of gravelly loamy coarse sand and soils that are cobbly from just beneath the surface to a depth of nearly 36 inches.

Runoff is medium, and the hazard of erosion is slight to moderate where this soil is left bare.

This soil is used mainly for irrigated small grains and pasture plants. Capability unit IIe-1 irrigated.

Gaviota Series

The Gaviota series consists of somewhat excessively drained, steep soils. These soils formed on uplands in material weathered from sandstone. Slopes are 30 to 50 percent. Elevation is 900 to 1,400 feet. Vegetation is chamise, annual grasses, forbs, and a few live oaks. The average annual precipitation is 10 to 16 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 250 to 300 days.

In a representative profile, the surface layer is brown and slightly acid or light-brown and neutral fine sandy loam about 15 inches thick over hard sandstone bedrock.

These soils are moderately rapidly permeable. Their available water capacity is about 1 to 2 inches. Roots penetrate to a depth of 10 to 15 inches.

These soils are used for spring grazing of livestock and for watershed.

Representative profile of Gaviota fine sandy loam, 30 to 50 percent slopes, in an area of Gaviota-Rock outcrop complex, about one-half mile north of Carbon Canyon Road and about one-half mile west of Western Hills Golf Course, SW¼NW¼NW¼ sec. 36, T. 2 S., R. 9 W.; San Bernardino base line and meridian:

A11—0 to 6 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many, very fine and fine, interstitial pores; slightly acid; clear, wavy boundary.

A12—6 to 15 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots; common, very fine, interstitial pores; neutral; abrupt, wavy boundary.

R—15 inches, light yellowish-brown (10YR 6/4) hard sandstone; neutral.

The A1 horizon is brown, light brown, pale brown, or grayish brown. Its texture is sandy loam or fine sandy loam. Structure is typically weak, fine or medium, subangular blocky. In places, however, the upper part is weak, fine, granular. Reaction is generally slightly acid to neutral, but it is neutral throughout in places. Thickness of the A horizon and depth to sandstone ranges from 10 to 15 inches but is about 15 inches in most places.

Gaviota-Rock outcrop complex (Go). —This complex occurs on steep foothills in the uplands. It is about 60 percent Gaviota fine sandy loam, 30 to 50 percent slopes, and 35 percent Rock outcrop. The Gaviota soil occurs at random throughout each mapped area. Rock outcrops are generally on ridgetops, and the Gaviota soil is on the sides of ridges.

Included with this complex in mapping are about 300 acres that have moderate sheet and rill erosion and slopes of 15 to 30 percent. In these included areas, outcrops of hard sandstone occupy only 1 to 2 percent of the surface. Also included are small areas of Fontana clay loam, 30 to 50 percent slopes.

Runoff is rapid, and the hazard of erosion is moderate to high if soils are left bare as a result of fire or overgrazing.

This Gaviota soil is used for spring grazing of livestock and for watershed. Capability unit VIIe-1 dryland.

Grangeville Series

The Grangeville series consists of somewhat poorly drained, nearly level soils. These soils formed on the slopes of alluvial fans in moderately coarse textured granitic alluvium. Slopes are 0 to 2 percent. Elevation is 1,000 to 1,200 feet. Vegetation is annual grasses and forbs and scattered cottonwood trees. The average annual precipitation is 12 to 15 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is grayish-brown fine sandy loam about 12 inches thick. The underlying material is light brownish-gray, mottled fine sandy loam that extends to a depth of 60 inches or more. Grangeville soils are calcareous and strongly alkaline throughout the profile.

These soils are moderately rapidly permeable. Their available water capacity is about 7 to 9 inches. Roots penetrate to a depth of 60 inches or more. Drainage has been improved by pumping ground water to lower the water table, and wetness is no longer a problem. Before the pumping was done, the water table was about 40 inches below the surface.

These soils are used for irrigated alfalfa, small grain, and pasture plants.

Representative profile of Grangeville fine sandy loam, saline-alkali, about 200 yards north of San Bernardino Freeway and about one-fourth mile west of Tippecanoe Avenue, SE¼SE¼SW¼ sec. 23, T. 1 S., R. 4 W; San Bernardino base line and meridian:

Ap—0 to 12 inches, grayish-brown (2.5YR 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) when moist; weak, fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; strongly effervescent; some lime occurring in soft masses; strongly alkaline; clear, smooth boundary.

C1—12 to 36 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, distinct, light olive-brown (2.5Y 5/4) mottles, olive-brown (2.5Y 4/4) when moist; weak, fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine and fine, tubular and interstitial pores; violently effervescent with some lime occurring in seams and in soft masses; strongly alkaline; gradual, wavy boundary.

C2—36 to 60 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) when moist; few, fine, distinct, light yellowish-brown (2.5Y 6/4) mottles, light olive brown (2.5Y 5/4) when moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common, very fine and fine, interstitial and tubular pores; violently effervescent, some segregated lime occurring in soft masses; strongly alkaline.

The A horizon is grayish brown or dark grayish brown. Its texture is fine sandy loam or sandy loam. Structure is generally weak or medium, fine, granular; it is weak, very fine, subangular blocky in a few places. Reaction ranges from moderately alkaline to strongly alkaline. Thickness is about 12 inches in most places but ranges from 10 to 17 inches. Soluble salts and excessive amounts of alkali salts occur in places.

The C horizon ranges from light brownish gray to light gray or pale olive. Infrequently the upper part of the C horizon, to a depth of 40 inches, is light yellowish brown. Mottles are always present below the A horizon. They are generally few, fine, faint to distinct olive-brown, light olive-brown, light-gray, light yellowish-brown, or yellowish-brown. Texture is typically fine sandy loam or sandy loam, but in places thin lenses of loam or clay loam occur below a depth of 40 inches. In places texture grades to loamy sand below a depth of 55 inches. Reaction is generally strongly alkaline but in places is moderately alkaline.

Grangeville fine sandy loam (Gr).—This nearly level soil is on the slopes of alluvial fans. It has a profile similar to the one described as representative of the series, but it is free of harmful accumulations of salt and alkali. Reaction is generally moderately alkaline throughout but in places is strongly alkaline below a depth of 36 inches.

Included with this soil in mapping are small areas of San Emigdio fine sandy loam and Chino silt loam. Small wet areas are identified on the map by wet spot symbols. Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated crops such as alfalfa and pasture plants. Dryfarmed small grains are also grown. Capability unit I irrigated.

Grangeville fine sandy loam, saline-alkali (Gs).—This nearly level soil occupies toe slopes of alluvial fans, mainly near the Tri-City Airport. It has the profile described as representative of the series. It is moderately saline and strongly alkali.

Included with this soil in mapping, and making up about 35 acres of the total mapped areas, are areas where the soil is silty clay throughout. This included soil occurs about three-fourths of a mile southwest of the intersection of Cucamonga Avenue and McCarthy Road near the Riverside County line. Small wet areas are shown on the map by the symbol for wet spots.

Runoff is slow, and the hazard of soil blowing is slight.

The content of salts and alkali limits the present use largely to pasture or other incidental uses. Capability unit IIIs-6 irrigated.

Greenfield Series

The Greenfield series consists of well-drained, gently sloping to strongly sloping soils. These soils formed on alluvial fans in moderately coarse textured granitic alluvium. Slopes are 2 to 15 percent. Elevation is 1,200 to 3,400 feet. Vegetation is chamise, annual grasses, and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is pale-brown sandy loam about 16 inches thick. The subsoil is yellowish-brown and light-brown fine sandy loam about 34 inches thick. The underlying material is light yellowish-brown sandy loam that extends to a depth of 60 inches or more. Greenfield soils are slightly acid in the surface layer and subsoil and neutral in the underlying material.

These soils are moderately rapidly permeable. Their available water capacity is about 7 to 9 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for irrigated crops such as citrus, alfalfa, and pasture plants. They are also used for dryfarmed small grains. Some areas are used for homesites and related uses.

Representative profile of Greenfield sandy loam, 2 to 9 percent slopes, about 100 feet north of Oak Glen Road; SE¼SW¼SW¼ sec. 29, T. 2 S., R. 1 W; San Bernardino base line and meridian:

A1—0 to 16 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 4/3) when moist; massive; hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, tubular pores; slightly acid; gradual, smooth boundary.

B21t—16 to 33 inches, yellowish-brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR (4/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine and fine roots; many, very fine and fine, tubular pores; few thin clay films on ped faces; very few thin clay films lining tubular pores; slightly acid; gradual, smooth boundary.

B22t—33 to 50 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5Y 4/4) when moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; few very fine roots; common, very fine and fine, tubular pores; few thin clay films on ped faces; slightly acid; gradual, smooth boundary.

C—50 to 60 inches, light yellowish-brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; neutral.

The A horizon is pale brown, grayish brown, or brown. Its texture is fine sandy loam, sandy loam, or coarse sandy loam. In places it is cobbly. Organic-matter content is low. Reaction ranges from slightly acid to neutral. Thickness ranges from 12 to 18 inches but is 16 inches in most places.

The B2t horizon is yellowish brown, light yellowish brown, light brown, or brown. Its texture is fine sandy loam or loam, and it contains slightly more clay than the A horizon. Structure is weak, fine or medium, subangular blocky or moderate, medium, subangular or angular blocky. Reaction ranges from slightly acid to neutral. Thickness ranges from 30 to 38 inches. In places a thin B1 horizon may occur.

The C horizon is light yellowish brown, yellowish brown, or brown. Its texture is sandy loam or coarse sandy loam. Reaction is neutral to mildly alkaline, and the C horizon is effervescent in some places.

Greenfield sandy loam, 2 to 9 percent slopes (GtC).—This gently sloping to moderately sloping soil is on alluvial fans. It has the profile described as representative of the series. Included with it in mapping are small, level areas that have slopes of 0 to 2 percent.

Also included are areas of Hanford coarse sandy loam.

Runoff is medium, and the hazard of erosion is moderate if the soil is unprotected.

This Greenfield soil is used for irrigated citrus, alfalfa, pasture plants, and dryfarmed small grains. Capability unit IIe-1 irrigated.

Greenfield sandy loam, 9 to 15 percent slopes (GtD).—This strongly sloping soil occupies alluvial fans. Included with it in mapping are small areas of Hanford coarse sandy loam and Ramona sandy loam.

Runoff is rapid, and the hazard of erosion is moderate to high where the soil is without vegetation.

This soil is used for citrus and dryfarmed small grains and pasture plants. Small areas are used for homesites and related uses. Capability unit IIIe-1 irrigated.

Greenfield cobbly sandy loam, 5 to 15 percent slopes (GuD).—This moderately sloping to strongly sloping soil occupies broad, short, alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is grayish brown sandy loam. Also cobblestones occupy about 15 percent of the surface area. Included with this soil in mapping are small patches of Ramona sandy loam and small areas of Hanford coarse sandy loam.

Runoff is medium, and the hazard of erosion is slight. The cobbly surface tends to reduce erosion activity somewhat. Available water capacity is about 6 to 8 inches.

This soil is used mainly for seeded dryfarmed pasture and for spring grazing of livestock. Capability unit IVs-7 irrigated.

Hanford Series

The Hanford series consists of well-drained, nearly level to strongly sloping soils that formed in recent granitic alluvium on valley floors and alluvial fans. Slopes are 0 to 15 percent. Elevation is 1,000 to 1,800 feet. Vegetation is mainly annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the soil material is pale-brown and very pale brown sandy loam to a depth of 60 inches or more. This material is slightly acid or neutral throughout.

These soils are moderately rapidly permeable. Their available water capacity is about 7 to 8 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for irrigated crops such as citrus, alfalfa, grapes, pasture plants, and small grains. Some areas are used for homesites.

Representative profile of Hanford sandy loam, 0 to 2 percent slopes, about 100 feet south of Palmetta Avenue and about one-fourth mile west of Nevada Avenue, NW¼NE¼SE¼ sec. 17, T. 1 S., R. 3 W.; San Bernardino base line and meridian:

Ap—0 to 12 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 4/3) when moist; massive; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; slightly acid; gradual, smooth boundary.

C1—12 to 32 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 4/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots; common, very fine and fine, interstitial and tubular pores; neutral; gradual, smooth boundary.

C2—32 to 60 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) when moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; few, very fine and fine, interstitial and tubular pores; neutral.

The A horizon is pale brown, light brownish gray, or brown. Its texture is sandy loam or coarse sandy loam. The soil is generally massive but may have weak, fine or medium, granular or subangular blocky structure. Thickness ranges from 8 to 14 inches but is 12 inches in most places.

The C horizon is pale brown, very pale brown, or light yellowish brown. Its texture is sandy loam, fine sandy loam, or coarse sandy loam. Reaction ranges from slightly acid to neutral but it may be mildly alkaline in some places. Some fine pebbles occur in a few places but generally do not exceed 5 percent by volume. Thin lenses of loam often occur.

Hanford coarse sandy loam, 2 to 9 perccent slopes (HaC).—This gently sloping to moderately sloping soil occupies alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is light brownish-gray coarse sandy loam about 10 inches thick. Included with it in mapping are areas of Greenfield sandy loam that make up as much as 10 percent of the total mapped areas. Also included are patches of Tujunga loamy sand, 0 to 5 percent slopes.

Runoff is slow to medium, and the hazard of erosion is slight to moderate where the soil is left unprotected.

This Hanford soil is used for irrigated crops such as citrus and alfalfa. It also is used for dryfarmed small grains and pasture plants. Homesites and other related uses are also important. Capability unit IIe-1 irrigated.

Hanford coarse sandy loam, 9 to 15 percent slopes (HaD).—This strongly sloping soil is on fans and terraces that have short side slopes. It has a profile similar to the one described as representative of the series, but the surface layer is brown coarse sandy loam about 10 inches thick. Included with it in mapping are areas of Greenfield sandy loam and Ramona sandy loam that each make up about 5 percent of the total area.

Runoff is medium, and the hazard of erosion is medium to high if the soil is left without plant cover.

This soil is used for citrus, grapes, and dryfarmed small grains. Some areas are used for homesites. Capability unit IIIe-1 irrigated.

Hanford sandy loam, 0 to 2 percent slopes (HbA).—This nearly level soil is on valley floors and toe slopes of alluvial fans. Included with it in mapping are small areas where slopes are 2 to 5 percent. Also included are small areas of Greenfield sandy loam, 2 to 9 percent slopes, and small scattered patches of soils that are loamy sand below a depth of 40 inches.

Runoff is slow, and the hazard of erosion is slight if the soil is left unprotected.

This soil is used for irrigated crops such as citrus, alfalfa, small grains, and pasture plants. Capability unit I irrigated.

Hilmar Series

The Hilmar series consists of somewhat poorly drained, nearly level soils on alluvial valley floors and fans. These soils formed in wind-laid coarse-textured material underlain by medium-textured granitic alluvium. Slopes are 0 to 2 percent. Elevation is 600 to 900 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is grayish-brown loamy fine sand about 13 inches thick. The underlying material, to a depth of 23 inches, is light yellowish-brown and grayish-brown loamy sand. Below this, to a depth of 60 inches, it is light brownish-gray mottled loam stratified with thin lenses of sandy loam and loamy sand. Hilmar soils are moderately alkaline throughout the profile and are slightly calcareous in the upper 23 inches and strongly calcareous below.

In these soils the surface layer and the upper part of the underlying material that formed in coarse-textured material are rapidly permeable. The lower part of the underlying material that formed in medium-textured material is slowly permeable. Available water capacity is about 7 to 9 inches. Roots penetrate to a depth of 60 inches or more. Originally the soils were somewhat poorly drained, but the drainage has been altered by lowering the ground water table through pumping.

These soils are used mainly for such irrigated crops as grapes, alfalfa, pasture plants, and small grains.

Representative profile of Hilmar loamy fine sand, about 100 feet south of Edison Road and about 200 feet west of Cucamonga Creek, SE¼NW¼NW¼ sec. 22, T. 2 S., R. 7 W; San Bernardino base line and meridian:

Ap—0 to 13 inches, grayish-brown (2.5Y 5/2) loamy fine sand, very dark grayish brown (2.5Y 3/2) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; many very fine and fine roots; slightly effervescent; moderately alkaline; gradual, smooth boundary.

C1—13 to 16 inches, light yellowish-brown (2.5Y 6/4) loamy sand, light olive brown (2.5Y 5/4) when moist; few, fine, distinct, brownish-yellow (10YR 6/6) mottles, yellowish brown (10YR 5/6) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; common very fine and fine roots; slightly effervescent; moderately alkaline; gradual, smooth boundary.

C2—16 to 23 inches, grayish-brown (2.5Y 5/2) loamy sand, light brownish gray (2.5Y 6/2) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; common very fine and fine roots; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

IIC3—23 to 60 inches, light brownish-gray (2.5Y 6/2) loam stratified with thin lenses of sandy loam and loamy sand, grayish brown (2.5Y 5/2) when moist; common, medium, distinct, brownish-yellow (10YR 6/6) mottles, yellowish brown (10YR 5/6) when moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; strongly effervescent; moderately alkaline.

The A horizon is grayish brown, dark grayish brown, or brown loamy fine sand or loamy sand. The soil material is dominantly single grained but has weak, very fine to fine, subangular blocky structure in small areas, and in some places it is massive. The soil material is slightly effervescent but is strongly effervescent in a few spots. The A horizon ranges from 8 to 14 inches in thickness but is 13 inches thick in most places.

The C horizon is generally light yellowish brown to grayish brown, but in a few places it is light brownish gray. Yellowish-brown, brownish-yellow, or dark yellowish-brown mottles are common. They range from few to common in abundance, fine to medium in size, and faint to distinct in contrast. The C horizon is loamy sand or loamy fine sand. The soil material is typically single grained, but in some places it is massive. Lime content varies from slight to strong. Thickness is about 10 inches but ranges from 8 to 12 inches.

The IIC horizon is light brownish gray, grayish brown, or light gray. Brownish-yellow or yellowish-brown mottles range from common to many in abundance, fine to medium in size, and distinct to prominent in contrast. The IIC horizon is generally loam that has thin lenses of sandy loam, coarse sandy loam, or loamy sand, but in a few places, it is clay loam or silt loam stratified with thin lenses of coarse-textured material. The IIC horizon is typically massive, but in some places it has weak, moderate, subangular blocky structure. Reaction ranges from mildly alkaline to strongly alkaline.

Hilmar loamy fine sand (Hr).—This nearly level soil is on valley floors and alluvial fans. Included with it in mapping are areas of Delhi fine sand that make up about 10 percent of each area. Also included are patches of Tujunga loamy sand, 0 to 5 percent slopes, and small areas where slopes are 2 or 3 percent.

Runoff is slow, and the hazard of water erosion is slight. If the soils are left without a protective cover of vegetation, the hazard of soil blowing is high.

The Hilmar soil is used chiefly for irrigated alfalfa, grapes, small grains, and pasture plants. Capability unit IIe-4 irrigated.

Merrill Series

The Merrill series consists of somewhat poorly drained, nearly level soils that formed on alluvial fans in medium-textured granitic alluvium. Slopes are 0 to 2 percent, elevation is 500 to 700 feet. Vegetation is mainly annual grasses and forbs, but perennial grasses grow in some areas. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is gray silt loam about 25 inches thick. The underlying material, to a depth of 43 inches, is light-gray loam that is weakly cemented and contains many extremely hard silica-lime cemented nodules. Below this the underlying material is light brownish-gray loam that extends to a depth of 60 inches or more. Merrill soils are strongly calcareous and moderately alkaline throughout their profile.

These soils are slowly permeable. Their available water capacity is 4 to 7 inches. Roots can penetrate to a depth of 25 to 40 inches. Drainage has been altered on these soils by pumping ground water for irrigation.

These soils are used for such irrigated crops as pasture plants, alfalfa, small grains, and some truck crops.

Representative profile of Merrill silt loam, about 300 feet northwest of Eucalyptus and Central Avenue;

SW¼SE¼SW¼ sec. 14, T. 2 S., R. 8 W.: San Bernardino base line and meridian:

Ap1—0 to 6 inches, gray (5Y 5/1) silt loam, dark olive gray (5Y 3/2) when moist; weak, coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many, very fine, interstitial pores; moderately alkaline; strongly effervescent; clear, smooth boundary.

Ap2—6 to 11 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine, tabular pores; moderately alkaline; strongly effervescent; clear, smooth boundary.

A13—11 to 20 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, coarse, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common, very fine tubular pores; moderately alkaline; strongly effervescent; gradual, wavy boundary.

A14—20 to 25 inches, gray (10YR 6/1) silt loam, dark gray (10YR 4/1) when moist; weak, coarse, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common, very fine, tubular pores; moderately alkaline; strongly effervescent; gradual, wavy boundary.

C1casi—25 to 31 inches, light-gray (2.5Y 7/2) loam that is weakly cemented with silica and lime, grayish brown (2.5Y 5/2) when moist; massive; hard, firm, slightly sticky and plastic; very few fine roots; mostly matted on the surface; very few, fine, tubular pores; 25 percent of the mass is irregularly shaped, extremely hard nodules that are cemented with silica and lime and are ½ to 1 inch in diameter; moderately alkaline; violently effervescent; gradual, wavy boundary.

C2casi—31 to 43 inches, light-gray (2.5Y 7/2) loam that is weakly cemented with silica and lime, grayish brown (2.5Y 5/2) when moist; hard, firm, slightly sticky and slightly plastic; no roots; few, very fine, tubular pores; 50 percent of the mass is irregularly shaped, extremely hard nodules that are cemented with silica and lime and are ½ to 1 inch in diameter; moderately alkaline; strongly effervescent; clear, wavy boundary.

C3—43 to 50 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few, very fine, tubular pores; moderately alkaline; strongly effervescent; gradual, wavy boundary.

C4—50 to 60 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few, very fine, tubular pores; moderately alkaline; slightly effervescent.

The A1 horizon is gray or dark gray and typically silt loam, but in places it is loam or fine sandy loam. The lower part of the A horizon is very fine sandy loam to silty clay loam. Structure is generally weak, fine to coarse, angular blocky or subangular blocky, but in places it is weak to moderate, fine, granular. Because this horizon contains disseminated lime it is strongly to violently effervescent. Thickness ranges from 19 to 25 inches but is about 25 inches in most places.

The Ccasi horizon typically is loam or silty clay loam. It is generally massive, but it has moderate or weak platy structure in places. The very hard or extremely hard silica-lime nodules range from 25 to about 50 percent, by volume. They range from ¼ to 1½ inches in diameter and also occur as indurated, discontinuous laminae 1 to 5 millimeters thick. In many places, the soil material can be augered only with much difficulty. Reaction ranges from moderately alkaline to strongly alkaline, and the material in this horizon is strongly to violently effervescent because it contains disseminated lime. The Ccasi horizon ranges from 18 to 24 inches in thickness but is generally about 18 inches thick.

The lower part of the C horizon is light brownish gray, grayish brown, or pale yellow. This horizon is loam, clay loam, or silty clay loam. In a few places below a depth of 40 inches, it is loamy sand. Reaction is moderately alkaline. The material is slightly to strongly effervescent.

Merrill silt loam (Me). —This nearly level soil occurs on alluvial fans. Included with it in mapping are small areas of Chino silt loam and Grangeville fine sandy loam.

Runoff is slow, and the hazard of erosion is slight.

This Merrill soil is used for irrigated pasture plants, alfalfa, small grains, and some truck crops. Capability unit IIIs-8 irrigated.

Metz Series

The Metz series consists of somewhat excessively drained, gently sloping to moderately sloping soils that formed in coarse-textured, mixed, recent alluvium on alluvial fans. Slopes are 2 to 9 percent. Elevation is 900 to 1,700 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 10 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 250 to 300 days.

In a representative profile, the surface layer is grayish-brown coarse sandy loam about 19 inches thick. The underlying material is light brownish-gray gravelly sand and loamy coarse sand that extends to a depth of 60 inches or more. Metz soils are mildly alkaline or moderately alkaline and slightly calcareous in the upper 19 inches and moderately alkaline and strongly calcareous to a depth of 60 inches.

These soils are moderately rapidly permeable. Their available water capacity is about 3 to 5 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for such irrigated crops as alfalfa, small grains, citrus, and pasture plants.

Representative profile of Metz coarse sandy loam, 2 to 9 percent slopes, about one-half mile south of San Timoteo Canyon Road, NW¼SW¼SW¼ sec. 10, T. 2 S., R. 3 W; San Bernardino base line and meridian:

A11—0 to 8 inches, grayish-brown (10YR 5/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; mildly alkline; gradual, smooth boundary.

A12—8 to 19 inches, grayish-brown (10YR 5/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many, very fine and fine, interstitial pores; slightly effervescent; moderately alkaline; abrupt, smooth boundary.

C1ca—19 to 29 inches, light brownish-gray (2.5Y 6/2) gravelly sand, grayish brown (2.5Y 5/2) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; few very fine and fine roots; about 20 percent gravel; strongly effervescent; some lime in soft masses; moderately alkaline; abrupt, smooth boundary.

C2ca—29 to 40 inches, light brownish-gray (10YR 6/4) loamy coarse sand, yellowish brown (10YR 5/4) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; few very fine roots; common, very fine and fine, interstitial pores; strongly effervescent; some lime in soft masses; moderately alkaline; abrupt, smooth boundary.

C3—40 to 60 inches, light brownish-gray (2.5Y 6/2) grav-

elly sand, grayish brown (2.5Y 5/2) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; about 25 percent gravel; strongly effervescent; some lime in soft masses; moderately alkaline.

The A1 horizon is grayish brown or light brownish gray. It is generally massive, but has weak, fine granular or subangular blocky structure in places. This horizon ranges from loam to sandy loam that is up to 15 percent pebbles in a few places. Thickness ranges from 10 to 19 inches but is about 19 inches in most places.

The C horizon is light brownish gray, pale brown, light yellowish brown, light gray, brownish gray, or light olive brown. It is generally single grained, in some places it is massive, but in a few places it has platy structure. Texture is sand, loamy coarse sand, or loamy sand, and thin lenses of fine gravel occur at random. In places the C horizon is stratified with thin, fine lenses of sandy loam below a depth of 40 inches. It is generally moderately alkaline, but it is mildly alkaline in a few spots. This horizon is slightly to strongly effervescent. In places the lower part of the C horizon contains soft masses or threads of lime.

Metz coarse sandy loam, 2 to 9 percent slopes (MgC).—This gently sloping to moderately sloping soil occupies alluvial fans that adjoin the uplands. Included with it in mapping are small areas of soils that have slopes of 0 to 2 percent.

Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight to moderate on bare soil.

This Metz soil is used for such irrigated crops as alfalfa, pasture plants, and small grains. Capability unit IIIs-4 irrigated.

Monserate Series

The Monserate series consists of moderately well drained, gently sloping to moderately sloping soils. These soils formed on alluvial fans and terraces in granitic alluvium. Slopes are 2 to 9 percent. Elevation is 800 to 1,200 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is brown sandy loam and fine sandy loam about 10 inches thick. The subsoil is strong-brown and reddish-brown clay loam about 20 inches thick. It is underlain by a yellowish-brown, indurated hardpan that is about 15 inches thick. Below the hardpan, to a depth of 60 inches or more, the underlying material is dark yellowish-brown coarse sandy loam. Monserate soils are slightly acid in the surface layer, neutral in the subsoil, and mildly alkaline below.

The subsoil of these soils is moderately slowly permeable, and the indurated hardpan is very slowly permeable. Available water capacity is about 4 to 7 inches. Roots penetrate to a depth of 30 to 40 inches.

These soils are used for such irrigated crops as small grains, alfalfa, and pasture plants. Dryfarmed small grains are also grown.

Representative profile of Monserate sandy loam, 2 to 9 percent slopes, about 300 feet north of Riverside Freeway, about 300 feet east of La Cadena Avenue; NE¼SE¼SW¼ sec. 6, T. 2 S., R. 4 W.; San Bernardino base line and meridian:

Ap—0 to 6 inches, brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, tubular pores; slightly acid; clear, smooth boundary.

A12—6 to 10 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine and fine, tubular pores; slightly acid; abrupt, smooth boundary.

B21t—10 to 24 inches, strong-brown (7.5YR 5/6) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure; very hard, very firm, sticky and plastic; common very fine and fine roots; common very fine and fine pores; common moderately thick clay films on ped faces and lining tubular pores; neutral; gradual, smooth boundary.

B22t—24 to 30 inches, reddish-brown (5Y 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard, very firm, sticky and plastic; few very fine and fine roots; few, very fine and fine, tubular pores; many moderately thick clay films on ped faces and lining tubular pores; neutral; abrupt, smooth boundary.

C1m—30 to 45 inches, yellowish-brown (10YR 5/4) indurated silica-cemented hardpan, dark yellowish brown (10YR 3/4) when moist; massive; extremely hard, extremely firm; no roots; mildly alkaline; gradual, smooth boundary.

C2—45 to 60 inches, yellowish-brown (10YR 5/4) coarse sandy loam, dark yellowish brown (10 YR 4/4) when moist; massive; very hard, very firm, nonsticky and nonplastic; mildly alkaline.

The A1 horizon is brown or dark brown. It is generally sandy loam or fine sandy loam, but in a few places it is loam. Structure ranges from moderate, medium, subangular blocky throughout to weak, fine or medium, granular. This horizon ranges from 10 to 15 inches in thickness but is commonly 10 inches thick. Reaction ranges from slightly acid to neutral.

The B2t horizon is strong brown to reddish brown. It is generally clay loam throughout; in places the upper part is sandy clay loam. Structure ranges from moderate, medium, prismatic to subangular blocky or angular blocky. Reaction is neutral in most areas; it is mildly alkaline in some spots. Thickness ranges from 20 to 25 inches but is 20 inches in most places.

The C1m horizon is yellowish brown to brown. In some places it has platy structure; in other places it is massive. Thickness ranges from 15 to 30 inches but is 15 to 20 inches on the average. Reaction is mildly alkaline to moderately alkaline. Depth to this horizon is 30 to 40 inches.

The C horizon below the hardpan is yellowish brown to light yellowish brown. Its texture is coarse sandy loam or sandy loam. Structure is typically weak, fine, subangular blocky, or the soil is massive. Reaction is mildly alkaline or moderately alkaline.

Monserate sandy loam, 2 to 9 percent slopes (MoC).—This gently sloping to moderately sloping soil is on alluvial fans. Included with it in mapping are small patches, 5 to 10 acres in size, of a soil that has slopes of 10 to 15 percent, areas of Greenfield sandy loam, and small scattered areas of Ramona sandy loam. Also included are about 195 acres where slopes are 0 to 2 percent.

Runoff is medium, and the hazard of erosion is slight to moderate if the soil is left without a protec-

tive cover of vegetation. The hazard of soil blowing is moderate. The indurated hardpan restricts the choice of crops and reduces available water capacity.

This soil is used for irrigated small grains, alfalfa, and pasture plants. Capability unit IIIe-8 irrigated.

Nacimiento Series

The Nacimiento series consists of well-drained, strongly sloping to steep soils that formed on uplands in material weathered from soft shale or fine grained sandstone. Slopes are 9 to 50 percent. Elevation is 800 to 1,400 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 250 to 280 days.

In a representative profile, the surface layer is dark grayish-brown clay loam about 28 inches thick. The underlying material is light yellowish-brown weathered sandstone that extends to a depth of 60 inches. Nacimiento soils are moderately alkaline and calcareous throughout their profile.

These soils are moderately slowly permeable. Their available water capacity is about 5 to 7 inches. Roots penetrate to a depth of 26 to 40 inches.

These soils are used for dryfarmed pasture plants and small grains, spring livestock grazing, and watershed.

Representative profile of Nacimiento clay loam, 30 to 50 percent slopes, about 200 yards northeast of the reservoir, about 20 yards north of a farm road on top of the slope; NW¼SE¼NW¼ sec. 31, T. 2 S., R. 8 W.; San Bernardino base line and meridian:

A11—0 to 8 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and coarse, granular structure; slightly hard, very friable, sticky and plastic; many very fine roots; many, very fine, tubular and interstitial pores; strongly effervescent; moderately alkaline; diffuse, smooth boundary.

A12—8 to 17 inches, dark grayish-brown (2.5 4/2) clay loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, medium and coarse, granular structure; slightly hard, very friable, sticky and plastic; common very fine roots; many, very fine, tubular and interstitial pores; strongly effervescent; moderately alkaline; diffuse, smooth boundary.

A13—17 to 28 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and coarse, granular structure; slightly hard, very friable, sticky and plastic; common very fine roots; many, very fine, tubular and interstitial pores; strongly effervescent; moderately alkaline; abrupt, smooth boundary.

C—28 to 60 inches, light yellowish-brown (2.5Y 6/4), weathered, fine-grained calcareous sandstone.

The A1 horizon is dark grayish brown or grayish brown. It is generally clay loam throughout, but in some places the lower part is silty clay loam. Structure may be weak or moderate, medium or coarse, granular to weak, moderate to strong, medium, subangular blocky. Thickness ranges from 20 to 32 inches but is about 28 inches in most places.

In places there is a thin C horizon of blocky, calcareous, pale-brown or light yellowish-brown clay loam. This horizon is about 6 to 8 inches thick and is above the weathered sandstone or shale. In most places the A1 horizon is immediately above the weathered rock.

Nacimiento clay loam, 9 to 30 percent slopes (NaE).—This moderately sloping to moderately steep soil is on uplands. Included with it in mapping are small areas of Fontana clay loam, 15 to 30 percent slopes, and patches of Alo clay, 30 to 50 percent slopes.

Runoff is medium to rapid, and the hazard of erosion is moderate.

This soil is used for dryfarmed small grains, spring grazing of livestock, and dryfarmed seeded pasture. Capability unit IVe-1 dryland.

Nacimiento clay loam, 30 to 50 percent slopes (NaF).—This steep soil is on uplands. It has the profile described as representative of the series. Included with it in mapping in some places are small areas that have sheet and rill erosion. Also included are areas of Fontana clay loam, 30 to 50 percent slopes, and small spots of Alo clay that are generally along drainageways in the steeper areas.

Runoff is rapid, and the hazard of erosion is moderate to high where soils are left without a protective cover of vegetation.

This soil is used for range in spring or for livestock grazing. It is also used for watershed. Capability unit VIe-1 dryland.

Oak Glen Series

The Oak Glen series consists of well-drained, gently sloping to moderately steep soils that formed on alluvial fans in alluvium derived from granite. Slopes are 2 to 30 percent. Elevation is 3,300 to 5,000 feet. Vegetation is annual grasses and forbs, oak trees, and some pine trees. The average annual precipitation is 14 to 25 inches, the mean annual air temperature is 52° to 56° F, and the frost-free season is 150 to 220 days.

In a representative profile, the surface layer is dark grayish-brown gravelly sandy loam about 20 inches thick. The underlying material is dark grayish-brown gravelly sandy loam that extends to a depth of 60 inches or more. Oak Glen soils are slightly acid throughout.

These soils are moderately rapidly permeable. Their available water capacity is about 5 to 7 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for apple orchards, dryfarmed small grains, and pasture plants.

Representative profile of Oak Glen gravelly sandy loam, 9 to 15 percent slopes, on the north side of Oak Glen Road about 7 miles north of Beaumont; NW¼ NW¼ sec. 36, T. 1 S., R. 1 W.; San Bernardino base line and meridian:

A11—0 to 10 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) when moist; moderate, very fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; slightly acid; diffuse, smooth boundary.

A12—10 to 20 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; slightly acid; diffuse, smooth boundary.

C—20 to 60 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2)

when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; few fine roots; slightly acid.

The A1 horizon is dark grayish brown or dark brown gravelly sandy loam to sandy loam; in some places it is coarse sandy loam that is 0 to 30 percent gravel. It typically has moderate, very fine or fine, granular structure, but in places it has weak, very fine or fine, subangular blocky. It is generally slightly acid, but it is medium acid in a few places. This horizon ranges from 20 to 28 inches in thickness but is 20 inches thick in most places.

The C horizon is dark grayish-brown, grayish-brown, dark-brown, or brown gravelly sandy loam or gravelly coarse sandy loam. It is 15 to 30 percent gravel, by volume. It ranges from weak, fine, granular to weak, very fine or fine, subangular blocky in structure. This horizon is massive in many places. It is slightly acid to neutral.

Oak Glen sandy loam, 2 to 9 percent slopes (OaC). —This gently sloping to moderately sloping soil is on alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is essentially free of pebbles. Included with it in mapping are patches, 5 to 10 acres in size, of a soil that has slopes of 0 to 2 percent.

The hazard of erosion is slight in places where the soil has a protective cover of vegetation.

This Oak Glen soil is used for apple orchards and dryfarmed small grains. Capability unit IIe-1 irrigated.

Oak Glen gravelly sandy loam, 9 to 15 percent slopes (OgD). —This strongly sloping soil is on short alluvial fans. It has the profile described as representative of the series. Included with it in mapping are patches, 5 to 10 acres in size, of soils that have a surface layer of loamy coarse sand and gravelly loamy coarse sand.

Runoff is medium, and the hazard of erosion is slight to moderate in areas where the surface layer is left without a protective cover of vegetation.

This soil is used for apple orchards, dryfarmed small grains, and pasture plants. Capability unit IIIe-1 irrigated.

Oak Glen gravelly sandy loam, 15 to 30 percent slopes (OgE). —This moderately steep soil is on short alluvial fans. Included with it in mapping are small scattered areas of soils that have a surface layer of cobbly loamy coarse sand or gravelly loamy coarse sand.

Runoff is rapid, and the hazard of erosion is moderate to high if the soil is not protected by a cover of vegetation.

This soil is used chiefly for spring livestock grazing. Small areas, where slopes are 15 to 20 percent, are used for orchards. Capability unit IVe-1 dryland.

Psamments and Fluvents, Frequently Flooded

Psamments and Fluvents, frequently flooded (Ps), consists of sandy and gravelly material in intermittent streambeds of the Santa Ana River, Mill Creek, Warm Creek, Cajon Creek, and other large creeks and their major tributaries. Some areas consist of cobbles, stones, and boulders. During each flood, alluvium from streambanks is freshly deposited and partly reworked.

Areas of this mapping unit have no value for farming. Their main use is as a source of sand and gravel for construction material. Vegetation is limited, consisting mainly of a scanty growth of annual grasses and forbs and a few willows and cottonwood trees. Capability unit VIIIw-1 dryland.

Ramona Series

The Ramona series consists of well-drained, gently sloping to moderately steep soils that formed on fans and terraces in granitic alluvium. Slopes are 2 to 30 percent. Elevation is 1,000 to 3,000 feet. Vegetation is chamise and annual grasses and forbs. The average annual precipitation is 12 to 18 inches, the mean annual air temperature is 59° to 62° F, and the frost-free season is 230 to 290 days.

In a representative profile, the surface layer is brown sandy loam and fine sandy loam about 23 inches thick. The subsoil is brown, yellowish-red, and reddish-yellow loam, clay loam, and sandy clay loam. It is about 31 inches thick. The underlying material is brownish-yellow sandy loam that extends to a depth of 60 inches or more. Ramona soils are slightly acid in the surface layer and neutral below.

These soils are moderately slowly permeable. Their available water capacity is 8 to 9 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for such irrigated crops as citrus, small grains, alfalfa, and pasture plants. Dryfarmed small grains are also grown. A few small areas are used for homesites and related uses.

Representative profile of Ramona sandy loam, 2 to 9 percent slopes, about 300 feet south of Barton Road and about 500 feet west of Alabama Street; NW¼ NE¼NW¼ sec. 32, T. 1 S., R. 3 W.; San Bernardino base line and meridian:

Ap—0 to 12 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; massive; hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many, very fine and fine, interstitial and tubular pores; slightly acid; clear, smooth boundary.

A12—12 to 23 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; massive; hard, very friable, slightly sticky and plastic; few very fine and fine roots; common, very fine and fine, tubular pores; slightly acid; clear, smooth boundary.

B1—23 to 32 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many, very fine and fine, tubular pores; very few thin clay films on ped faces and lining tubular pores; neutral; clear, smooth boundary.

B21t—32 to 40 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; common, very fine and fine, interstitial pores; common moderately thick clay films on ped faces; neutral; gradual, smooth boundary.

B22t—40 to 48 inches, yellowish-red (5Y 5/6) clay loam, yellowish red (5YR 5/6) when moist; moderate, coarse, angular blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; common, very fine and fine, interstitial and tubular pores; many moderately thick clay films on ped faces; neutral; gradual, smooth boundary.

B3—48 to 54 inches, reddish-yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) when moist;

moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; very few fine roots; few, very fine and fine, tubular pores; very few thin clay films lining pores; neutral; gradual, smooth boundary.

C—54 to 60 inches, brownish-yellow (10YR 6/6) sandy loam, yellowish brown (10YR 5/6) when moist; massive; slightly hard, friable, nonsticky and nonplastic; few, very fine and fine, tubular pores; neutral.

The A1 horizon is pale brown to strong brown. Reaction is generally slightly acid; it is medium acid in a few spots. Thickness ranges from 16 to 25 inches but averages about 23 inches in most places.

The B2t horizon is commonly brown, strong brown, or yellowish red, but in some places it is reddish yellow or reddish brown. It is sandy clay loam or clay loam. It has weak or moderate, medium or coarse, subangular or angular blocky structure. It is typically neutral, but it may be mildly alkaline in the lower part. This horizon ranges from 16 to 36 inches in thickness but is generally about 16 inches thick.

The C horizon is brownish yellow or yellowish brown sandy loam or coarse loam. In some areas thin lenses of loam or gravel. This horizon is generally massive but has weak or medium, angular or subangular blocky structure in some places. It is generally neutral, but it is mildly alkaline and slightly effervescent in a few places.

Ramona sandy loam, 2 to 9 percent slopes (RmC).—This gently sloping to moderately sloping soil occupies long alluvial fans and low terraces associated with steeper areas on uplands. It has the profile described as representative of the series. Included with it in mapping are patchy areas of Greenfield sandy loam and Monserate sandy loam. Also included are a few small areas that have moderate sheet and rill erosion. Shallow gullies cut a few areas.

Runoff is medium, and the hazard of erosion is moderate where the soil is not protected by vegetation.

This Ramona soil is used for dryfarmed small grains and irrigated citrus, alfalfa, small grains, and pasture. Some areas once used for crops are now used for homesites and related uses. Capability unit IIe-1 irrigated.

Ramona sandy loam, 9 to 15 percent slopes (RmD).—This strongly sloping soil is on short terraces mainly in uplands. Included with it in mapping are small areas of Greenfield sandy loam. Shallow gullies are present in some areas, and there are a few deep gullies. In places small patches of soils have moderate sheet and rill erosion.

Runoff is medium. If the soil is not protected by a cover of vegetation, the hazard of erosion is moderate to high.

This soil is used for dryfarmed small grains and pasture plants. Some small areas are used for citrus. Homesites and other related uses are becoming more important. Capability unit IIIe-1 irrigated.

Ramona sandy loam, 15 to 30 percent slopes, eroded (RmE2).—This moderately steep soil is on upland terraces that have short side slopes. Slopes near Redlands are complex in many places. The soil has a profile similar to the one described as representative of the series, but the surface layer is pale brown or brown and is about 16 or 17 inches thick. Sheet and rill erosion are moderate in most areas. Many areas have shallow gullies, but some areas have a few deep gullies.

Included with this soil in mapping are small areas of Greenfield sandy loam, 9 to 15 percent slopes. Also included are small patches, 2 to 5 acres in size, of Monserate sandy loam, 2 to 9 percent slopes.

Runoff is medium to rapid, and the hazard of erosion is moderate to high on bare soil. This soil is used mainly for dryfarmed pasture. Less sloping areas are commonly used for citrus. Capability unit IVe-1 irrigated.

San Emigdio Series

The San Emigdio series consists of well-drained, nearly level to strongly sloping soils. These soils formed on alluvial fans in somewhat mixed alluvium derived mainly from sedimentary materials. Slopes are 0 to 15 percent. Elevation is 1,000 to 2,000 feet. Vegetation is chamise, annual grasses, and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is light brownish-gray fine sandy loam. The underlying material is pale-brown fine sandy loam that extends to a depth of 60 inches or more. San Emigdio soils are moderately alkaline and calcareous throughout.

These soils are moderately rapidly permeable. Their available water capacity is about 7 to 9 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for irrigated small grains, citrus, alfalfa, and pasture plants.

Representative profile of San Emigdio fine sandy loam, 2 to 9 percent slopes, about 300 feet east of San Timoteo Canyon Road and about one-fourth mile south of the Fern Avenue and San Timoteo Canyon Road intersection; SW¼NW¼ sec. 4, T. 2 S., R. 3 W; San Bernardino base line and meridian:

A1—0 to 8 inches, light brownish-gray (10YR 6/2) fine sandy loam, brown (10YR 5/3) when moist; weak, fine granular structure; soft, very friable, nonsticky and nonplastic; many, very fine roots; many, very fine, tubular pores; moderately alkaline; violently effervescent; some lime in fine threads; clear, smooth boundary.

C1—8 to 14 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/4) when moist; weak, fine, subangular blocky structure; hard, friable, nonsticky and nonplastic; many very fine roots; many, very fine tubular pores; moderately alkaline; violently effervescent; some lime in fine threads; clear, smooth boundary.

C2ca—14 to 38 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; weak, fine angular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common, very fine, tubular pores; moderately alkaline; violently effervescent; some lime in fine threads and soft masses; gradual, wavy boundary.

C3ca—38 to 60 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; weak, fine, angular blocky structure; hard, friable, slightly sticky and slightly plastic, few very fine roots; few very fine tubular pores; moderately alkaline; violently effervescent; some lime in fine threads and soft masses.

The A1 horizon is light brownish gray or grayish brown fine sandy loam or sandy loam. It has weak, fine to medium, granular structure. It is generally moderately alkaline but is mildly alkaline in spots. The A1 horizon is slightly to violently effervescent, and in some areas, lime occurs in threads or filaments. This horizon ranges from 7 to 10

inches in thickness but is 8 inches thick in most places. In some areas it is 15 to 25 percent gravel, by volume.

The C horizon is pale brown, very pale brown, or light gray. It is generally sandy loam or fine sandy loam, but in a few places it is coarse sandy loam below a depth of 44 inches. Thin lenses of loam, silt loam, or very fine sandy loam are common at depths of 36 to 60 inches. This horizon has weak, fine, subangular or angular blocky structure, but in many places it is massive.

San Emigdio sandy loam, 9 to 15 percent slopes (SaD). —This strongly sloping soil occupies narrow, long, alluvial fans in side canyons. In some places at the head of draws are a few shallow gullies. Included with this soil in mapping are areas of Hanford coarse sandy loam that occur at random in patches 5 to 10 acres in size.

Runoff is slow to medium, and the hazard of erosion is moderate in places where the soil does not have a protective cover of vegetation. Available water capacity is 7 to 8 inches.

This soil is used chiefly for dryfarmed small grain and pasture plants. In places there are irrigated citrus plantings. Capability unit IIIe-1 irrigated.

San Emigdio gravelly sandy loam, 2 to 9 percent slopes (SbC). —This gently sloping to moderately sloping soil is on rather narrow alluvial fans. It has a profile similar to the one described as representative of the series, but the upper 12 to 16 inches is 15 to 25 percent gravel, by volume.

Included with this soil in mapping are small areas of Metz coarse sandy loam and Hanford coarse sandy loam. Also included are areas of depositional soil material of various textures. This material is 1 to 3 feet deep and is along intermittent drainageways. It is a result of the 1969 floods.

Runoff is slow to medium. Available water capacity is about 7 to 8 inches. The hazard of erosion is slight. Gravel helps protect much of the surface.

This soil is used for irrigated alfalfa, small grains, and pasture plants. Some citrus is grown. Capability unit IIe-1 irrigated.

San Emigdio fine sandy loam, 0 to 2 percent slopes (ScA). —This nearly level soil is on alluvial fans that are mainly near Loma Linda. Included with it in mapping are small patches of Metz coarse sandy loam, 2 to 9 percent slopes. Also included are areas of Hanford sandy loam and small patches of soil that has a surface layer of gravelly sandy loam.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is about 5 to 9 inches.

This soil is used for irrigated small grains, citrus, and pasture plants. Small areas are used for homesites and related uses. Capability unit I irrigated.

San Emigdio fine sandy loam, 2 to 9 percent slopes (ScC). —This gently sloping to moderately sloping soil occupies alluvial fans. It has the profile described as representative of the series. Included with it in mapping are small areas, 5 to 10 acres in size, of San Emigdio sandy loam, 9 to 15 percent slopes. Also included are areas of Hanford coarse sandy loam and small patches where the surface layer is gravelly sandy loam.

Runoff is slow, and the hazard of erosion is slight to moderate on bare soil. Available water capacity is about 5 to 8 inches.

This soil is used for such irrigated crops as alfalfa, small grains, and pasture plants. Capability unit IIe-1 irrigated.

San Timoteo Series

The San Timoteo series consists of well-drained, steep soils. These soils formed on uplands in material derived from soft, weathered sandstone. Slopes are 30 to 50 percent. Elevation is 1,200 to nearly 3,000 feet. Vegetation is chamise, annual grasses, and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 240 to 280 days.

In a representative profile, the surface layer is grayish-brown and pale-brown loam about 13 inches thick. The underlying material, to a depth of 24 inches, is very pale brown loam. Below this is very pale brown, soft, calcareous sandstone that extends to a depth of 60 inches or more. San Timoteo soils are moderately alkaline and calcareous throughout.

These soils are moderately permeable. Their available water capacity is about 4 to 5 inches. Roots penetrate to a depth of 24 to 30 inches.

These soils are used for seeded pasture, spring grazing of livestock, and watershed.

Representative profile of San Timoteo loam, 30 to 50 percent slopes, eroded, about 300 feet south of West Avenue F, about 500 feet northeast of San Bernardino Freeway No. 10; NE¼NE¼SW¼ sec. 9, T. 2 S., R. 2 W.; San Bernardino base line and meridian:

A11—0 to 10 inches, grayish-brown (10YR 5/2) loam; weak, fine, granular structure; soft, very friable, nonsticky and slightly plastic; many very fine and fine roots; many, very fine and fine, interstitial pores; violently effervescent; some lime in soft masses; moderately alkaline; clear, smooth boundary.

A12—10 to 13 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; soft, very friable, nonsticky and slightly plastic; many very fine and fine roots; common, very fine and fine, interstitial pores; violently effervescent; some lime in soft masses; moderately alkaline; clear, smooth boundary.

C1—13 to 24 inches, very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) when moist; massive; soft, very friable, nonsticky and slightly plastic; common very fine and fine roots; few, very fine and fine, interstitial pores; violently effervescent; some lime in soft masses; moderately alkaline; abrupt, smooth boundary.

C2—24 to 60 inches, very pale brown (10YR 7/4), soft, calcareous sandstone that crushes to sandy loam when rubbed; light yellowish brown (10YR 6/4) when moist; violently effervescent.

The A1 horizon is grayish brown, light brownish gray, pale brown, or light gray. It is generally loam, but in small areas it is fine sandy loam or sandy loam. It ranges from weak, fine, granular to crumb or subangular blocky in structure throughout, but in places it is massive in the lower part. This horizon is generally moderately alkaline, but it is mildly alkaline in spots. It is strongly effervescent or violently effervescent. It averages about 13 inches thick but ranges from 10 to 16 inches in thickness.

The upper part of the C horizon is very pale brown or pale-brown sandy loam or loam. It is generally massive but has weak, fine, subangular blocky structure in places. Seg-

regated lime occurs as soft masses, seams, or threads. Depth to the sandstone is 24 to 30 inches.

San Timoteo loam, 30 to 50 percent slopes, eroded (SgF2).—This steep soil is on uplands. Sheet and rill erosion are moderate in most areas. Shallow gullies are present in some places. Included with this soil are patches, 10 to 30 acres in size, where slopes range from 20 to 30 percent. Also included are areas of Saugus sandy loam, 30 to 50 percent slopes.

Runoff is rapid, and the hazard of erosion is moderate to high in places where soil is left bare.

This San Timoteo soil is used for seeded pasture, spring livestock grazing, and watershed purposes. Capability unit VIe-1 dryland.

Saugus Series

The Saugus series consists of well-drained, steep soils. These soils formed on uplands in weakly consolidated sediment. Slopes are 30 to 50 percent. Elevation is 1,200 to 2,500 feet. Vegetation is chamise, annual grasses, and forbs. The average annual precipitation is 14 to 16 inches, the mean annual air temperature is 62° to 65° F, and the frost-free season is 250 to 280 days.

In a representative profile, the surface layer is brown sandy loam about 8 inches thick. The underlying material, to a depth of 40 inches, is yellowish-brown sandy loam or loam. Below this it is weakly consolidated loamy sediments. Saugus soils are neutral in the surface layer and slightly acid below.

These soils are moderately permeable. Their water capacity is 5 to 6 inches. Roots can penetrate to a depth of 40 to 50 inches.

These soils are used for watershed and for some livestock grazing in spring.

Representative profile of Saugus sandy loam, 30 to 50 percent slopes, about 300 yards south of South Sunset Drive; NW¼NE¼SE¼ sec. 7, T. 2 S., R. 2 W.; San Bernardino base line and meridian:

A1—0 to 8 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; neutral; clear, smooth boundary.

C1—8 to 18 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; gradual, smooth boundary.

C2—18 to 40 inches, yellowish-brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few medium and coarse roots and common very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; abrupt, smooth boundary.

C3—40 to 60 inches, yellowish-brown (10YR 5/4), weakly consolidated loamy sediment; massive; slightly acid.

The A1 horizon is brown, dark yellowish brown, or grayish brown. Its texture is sandy loam or loam. Structure ranges from weak, fine, granular to weak or moderate, fine or medium, subangular blocky. Reaction ranges from slightly acid to neutral. Thickness is generally 8 inches, but it is as much as 12 inches in some places.

The C horizon is light yellowish brown, yellowish brown, or pale brown. In places it has thin lenses of loamy coarse sand or gravelly sandy loam. This horizon has weak or moderate, fine or medium, subangular blocky structure. It is slightly acid to neutral. Typically, depth to weakly consolidated sediment is 40 to 50 inches.

Saugus sandy loam, 30 to 50 percent slopes (ShF).—This steep soil is mainly on foothills in uplands, but it also occurs throughout a large part of the survey area on steep, escarpment-like relief where the parent material is soft granitic or sedimentary material.

Included with this soil in mapping are small scattered spots where gravel and cobbles are on the surface. Also included are areas of soils, 10 to 15 acres in size, that have moderate sheet and rill erosion. There are a few shallow gullies in some areas and one or two deep gullies in a few areas. Also included are areas of San Timoteo loam, 30 to 50 percent slopes, eroded, as well as a few places that have slopes of as much as 65 percent.

Runoff is rapid, and the hazard of erosion is moderate to high in places where soil is left bare.

This Saugus soil is used for watershed and for limited spring grazing of livestock. Capability unit VIIe-1 dryland.

Soboba Series

The Soboba series consists of excessively drained, nearly level to moderately sloping soils. These soils formed on alluvial fans in granitic alluvium. Slopes are 0 to 9 percent. Elevation is 900 to 2,200 feet. Vegetation is chamise, annual grasses, and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is grayish-brown stony loamy sand about 10 inches thick. The underlying material is brown very stony loamy sand and very pale brown very stony sand that extends to a depth of 60 inches or more. Soboba soils are slightly acid in the upper 24 inches and neutral to a depth of 60 inches.

These soils are very rapidly permeable. Their available water capacity is about 2 to 3 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used mainly for irrigated citrus and dryfarmed seeded pasture.

Representative profile of Soboba stony loamy sand, 2 to 9 percent slopes, about one-half mile east of Crafton Street and about one-half mile north of Mentone Blvd.; NE¼NW¼SW¼ sec. 20, T. 1 S., R. 2 W.; San Bernardino base line and meridian:

Ap—0 to 10 inches, grayish-brown (10YR 5/2) stony loamy sand, dark grayish brown (10YR 4/2) when moist; single grained; loose when dry or moist, nonsticky and nonplastic; many very fine and fine roots; many, very fine, interstitial pores; about 10 percent rounded stones and 10 percent gravel; slightly acid; clear, smooth boundary.

C1—10 to 24 inches, brown (10YR 5/3) very stony loamy sand, dark brown (10YR 4/3) when moist; single grained; loose when dry and moist, nonsticky and

nonplastic; many very fine roots; many, very fine, interstitial pores; about 40 percent rounded stones 12 to 15 inches in diameter and 5 percent fine gravel; slightly acid; gradual, smooth boundary.

C2—24 to 60 inches, very pale brown (10YR 7/3) very stony sand, pale brown (10YR 6/3) when moist; single grained; loose when dry and moist, nonsticky and nonplastic; common very fine roots; many, very fine, interstitial pores; about 45 percent rounded stones 10 to 16 inches in diameter and 10 percent fine gravel and a few cobbles; neutral.

The A horizon is grayish brown or dark grayish brown stony loamy sand or gravelly loamy sand. This horizon is generally single grained but has weak, very fine, subangular blocky structure in some places. It is slightly acid in most places but is medium acid in spots. It averages 10 inches but ranges from 8 to 14 inches in thickness.

The C horizon is grayish brown, brown, pale brown, very pale brown, or light yellowish brown. In places cobbles instead of stones make up the coarse fragments. In places stones make up 35 to 55 percent, by volume, of this horizon. Gravel ranges from 5 to 15 percent in some areas and 40 to 60 percent in others. This horizon is typically single grained, but in some places it is massive. Reaction is generally neutral throughout but is mildly alkaline at depths below 40 inches in some areas.

Soboba gravelly loamy sand, 0 to 9 percent slopes (SoC).—This nearly level to moderately sloping soil is on long, broad alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is gravelly and the soil material is very gravelly loamy sand to a depth of about 36 inches. By volume, gravel ranges from about 40 to 60 percent. Very stony sand or very cobbly loamy sand extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Tujunga gravelly loamy sand in scattered tracts 10 to 20 acres in size. Also included are small areas of nearly level Delhi fine sand. In addition to these are small areas west of Upland, north of San Bernardino Freeway, where the surface layer is very dark grayish brown.

Runoff is very slow, and the hazard of erosion is slight.

This soil is used mainly for dryfarmed seeded pasture. Some areas are used for irrigated citrus. Capability unit VIs-1 dryland.

Soboba stony loamy sand, 2 to 9 percent slopes (SpC).—This gently sloping to moderately sloping soil is on long, broad, smooth alluvial fans. It has the profile described as representative of the series. Included with it in mapping are small areas, 20 to 40 acres in size, where slopes are 0 to 2 percent. Also included are random patches of areas of Tujunga gravelly loamy sand.

Runoff is slow, and the hazard of erosion is slight.

This Soboba soil is used mainly for dryfarmed seeded pasture. Some areas are used for citrus. Capability unit VIs-1 dryland.

Soper Series

The Soper series consists of well-drained, moderately steep to steep soils that formed on uplands in material weathered from weakly consolidated sandstone or conglomerate. Slopes are 15 to 50 percent. Elevation is 700 to 1,500 feet. Vegetation is annual grasses and forbs and scattered live oak trees. The average annual precipitation is 10 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 250 to 280 days.

In a representative profile, the surface layer is dark grayish-brown gravelly loam about 12 inches thick. The subsoil is brown, light yellowish-brown, and yellowish-brown gravelly sandy clay loam about 14 inches thick. It is underlain by very pale brown, yellowish-brown, and pale-yellow, soft, stratified sandy conglomerate and marine sandstone that extends to a depth of 60 inches or more. Soper soils are neutral in the surface layer and mildly alkaline and neutral in the subsoil.

These soils are moderately slowly permeable. Their available water capacity is about 4 to 5 inches. Roots can penetrate to a depth of 22 to 36 inches.

These soils are used for dryfarmed seeded pasture and watershed.

Representative profile of Soper gravelly loam, 30 to 50 percent slopes, about 4 miles south of Chino and about 0.4 mile southwest of Pomona-Rincon Road in a gravel pit; NE¼NW¼ sec. 35, T. 2 S., R. 8 W.; San Bernardino base line and meridian:

A1—0 to 12 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky and plastic; many fine and very fine roots; many, fine, tubular pores; neutral; clear, smooth boundary.

B21t—12 to 17 inches, brown (10YR 4/3) gravelly sandy loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; many, very fine, medium, and coarse roots; many, medium pores; common moderately thick clay films on ped faces and lining pores; mildly alkaline; abrupt, smooth boundary.

B22t—17 to 26 inches, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/4) gravelly sandy clay loam, dark yellowish brown (10YR 4/4) when moist; moderate, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; many, fine, medium, and coarse roots; many, medium, tubular pores; common moderately thick clay films on ped faces; neutral; abrupt, smooth boundary.

C1—26 to 50 inches, very pale brown (10YR 7/4) and yellowish brown (10YR 5/4), soft, sandy conglomerate; massive; slightly acid; abrupt, smooth boundary.

IIC2—50 to 60 inches, pale-yellow (2.5Y 7/4) soft marine sandstone.

The A1 horizon is dark grayish brown or dark brown. Its texture is generally gravelly loam but is loam or heavy loam in some places. Structure ranges from weak to moderate, medium, subangular blocky. Reaction is slightly acid to neutral. Thickness is about 12 inches in most places but ranges from 10 to 16 inches. This horizon is 5 to 15 percent gravel.

The B2t horizon is brown, yellowish brown, light yellowish brown, or dark grayish brown clay loam, gravelly clay loam, or gravelly sandy clay loam. It ranges from 5 to 15 percent gravel, by volume, and the pebbles are generally rounded and ½ to ¾ inch in size. A few rounded cobbles occur in places. This horizon has subangular or angular blocky structure. It ranges from 12 to 20 inches in thickness but is about 14 inches thick in most places. It is commonly neutral to mildly alkaline but is slightly acid in some places. Depth to the C horizon ranges from 22 to 36 inches.

Soper gravelly loam, 15 to 30 percent slopes (SrE).—This moderately steep soil is on uplands. Included with it in mapping are areas, 10 to 15 acres in size, where slope is 8 to 15 percent. Small patches of cobbles occur on the surface. Also included are areas of Fontana clay loam, 15 to 30 percent slopes, and small areas of Gaviota-Rock outcrop complex.

Runoff is rapid, and the hazard of erosion is moderate in places where the soil is left bare and unprotected.

This Soper soil is used mainly for dryfarmed seeded pasture and watershed. Capability unit VIe-1 dryland.

Soper gravelly loam, 30 to 50 percent slopes (SrF).—This steep soil occupies uplands. It has the profile described as representative of the series. Included with it in mapping are small areas of Fontana clay loam. Also included are areas of Gaviota-Rock outcrop complex. A few shallow gullies occur, and some deep gullies cut a few areas.

Runoff is rapid, and the hazard of erosion is moderate to high in places where the soil is left unprotected by vegetative cover.

This soil is used for dryfarmed pasture and watershed purposes. Capability unit VIIe-1 dryland.

Sorrento Series

The Sorrento series consists of well-drained, nearly level to gently sloping soils. These soils formed on alluvial fans in alluvium derived from mixed granitic and sedimentary sources. Slopes are 0 to 5 percent. Elevation is 600 to 800 feet. Vegetation is annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 245 to 280 days.

In a representative profile, the surface layer is dark grayish-brown clay loam about 38 inches thick. The underlying material is brown clay loam that extends to a depth of 60 inches or more. Sorrento soils are neutral to a depth of 30 inches, mildly alkaline between depths of 30 and 38 inches, and moderately alkaline. They are calcareous below a depth of about 47 inches. These soils are moderately slowly permeable. Their available water capacity is about 10 to 11 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for such irrigated crops as alfalfa, small grains, pasture plants, and sudangrass.

Representative profile of Sorrento clay loam, 0 to 2 percent slopes, about 300 yards east of brickyard and about 400 yards south of Pomona-Rincon Road; SE¼SW¼SW¼ sec. 26, T. 2 S., R. 8 W.; San Bernardino base line and meridian:

A11—0 to 15 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; common fine and medium roots; common, fine and very fine, tubular pores; neutral; diffuse, wavy boundary.

A12—15 to 30 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; common, fine and very fine, tubular pores; neutral; diffuse, wavy boundary.

A13—30 to 38 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, angular blocky structure; hard, friable, sticky and plastic; common, fine and very fine, tubular pores; mildly alkaline; clear, wavy boundary.

C1—38 to 47 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) when moist; moderate, medium, angular blocky structure; hard, friable, sticky and plastic; few very fine roots; common, very fine, tubular pores; moderately alkaline; clear, wavy boundary.

C2ca—47 to 60 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; moderate, medium, angular blocky structure; hard, friable, sticky and plastic; few very fine roots; few, very fine, tubular pores; strongly effervescent; lime coatings on ped faces, in seams, and in threads; moderately alkaline.

The A1 horizon is dark grayish brown or dark gray. It has weak to strong, medium or coarse, subangular or angular blocky structure, but in a few places it has moderate, medium or coarse, granular structure in the upper part. This horizon is generally neutral to mildly alkaline with increasing depth, but in a few spots it is slightly acid in the upper few inches. It ranges from 24 to 38 inches in thickness but is about 38 inches thick in most places.

The C horizon is brown, dark grayish brown, or grayish brown. It has weak or moderate, medium, subangular or angular blocky structure, but in some places the lower part is massive. It is, typically, moderately alkaline.

In this survey area Sorrento soils tend to have disseminated and segregated lime at a lower depth in the profile than is within the defined range for the Sorrento series. This difference does not alter the usefulness and behavior of these soils.

Sorrento clay loam, 0 to 2 percent slopes (StA).—This nearly level soil is on alluvial fans. It has the profile described as representative of the series. Included with it in mapping are small areas where slopes are 2 or 3 percent. Late in spring and early in summer small, temporary wet spots, 2 to 4 acres in size, may appear. These spots are caused by seepage from adjacent higher areas.

Runoff is medium to slow, and the hazard of erosion is slight.

This Sorrento soil is used for irrigated alfalfa, pasture plants, small grains, and sudangrass. Capability unit I irrigated.

Sorrento clay loam, 2 to 5 percent slopes (StB).—This gently sloping soil is on alluvial fans. Included with it in mapping are small areas of Garretson very fine sandy loam, 2 to 9 percent slopes. Also included are a few places, mainly south and north of Boys Republic west of Highway 71, where the underlying material is clay at a depth of 44 to 60 inches.

Runoff is medium, and the hazard of erosion is slight to moderate.

This Sorrento soil is used for irrigated pasture, small grains, and silage crops. Capability unit IIe-1 irrigated.

Tollhouse Series

The Tollhouse series consists of excessively drained, steep soils that formed on uplands in material weathered from granitic rock. Slopes are 30 to 50 percent. Elevation is 4,000 to 6,000 feet. Vegetation is annual

grasses and forbs, manzanita, live oak, and pine trees. The average annual precipitation is 14 to 25 inches, the mean annual air temperature is 52° to 57° F, and the frost-free season is 160 to 210 days.

In a representative profile, the surface layer is dark grayish-brown and brown sandy loam about 12 inches thick. It is underlain by very pale brown weathered granitic rock that extends to a depth of 60 inches or more. Tollhouse soils are slightly acid throughout the profile.

These soils are moderately rapidly permeable. Their available water capacity is about 1 to 3 inches. Roots can penetrate to a depth of 10 to 20 inches.

These soils are used for watershed and for spring grazing of livestock.

Representative profile of Tollhouse sandy loam, 30 to 50 percent slopes, on the north side of the Forest Service Road on the edge of a firebreak about one-fourth of a mile north of Pisgah Peak; NE¼SE¼ SE¼ sec. 35, T. 1 S., R. 1 W.; San Bernardino base line and meridian:

A11—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial and tubular pores; slightly acid; clear, smooth boundary.

A12—8 to 12 inches, brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; abrupt, wavy boundary.

C—12 to 60 inches, very pale brown (10YR 7/4) weathered granitic rock.

The A1 horizon is dark grayish brown, dark brown, or brown. Its texture is sandy loam or fine sandy loam. Structure is typically weak or moderate, fine or medium, granular. Thickness ranges from 10 to 18 inches but is about 12 inches in most areas. Reaction is typically slightly acid, but in a few places it is medium acid or neutral. In places there is a thin C horizon of brown or pale-brown sandy loam or loam that contains fragments of parent material. Where this horizon occurs, it generally has moderate, medium, blocky structure, but in places it is massive. In most places, the A1 horizon is directly underlain by weathered parent material. Depth to weathered granite is 10 to 20 inches, and depth to hard rock varies from place to place and in many places within a short distance. In nearly all areas the depth to hard rock is more than 40 inches.

Tollhouse sandy loam, 30 to 50 percent slopes (ToF).—This steep soil is on foothills and mountains. Included with it in mapping are small, moderately steep areas, about 10 to 25 acres in size, where slopes range from 15 to 25 percent. Also included are areas of Cieneba-Rock outcrop complex.

Runoff is rapid to very rapid. The hazard of erosion is moderate to high in places where soil is left bare.

This Tollhouse soil is used for spring grazing of livestock and watershed. Capability unit VIIe-1 dryland.

Tujunga Series

The Tujunga series consists of somewhat excessively drained, nearly level to moderately sloping soils that formed on alluvial fans in granitic alluvium. Slopes are 0 to 9 percent. Elevation is 1,000 to 2,000 feet. Vegetation is thin strands of chamise, some big sagebrush, and annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the soil is brown loamy sand and pale-brown coarse sand that extends to a depth of 60 inches or more. Tujunga soils are slightly acid throughout their profile.

The Tujunga soils are rapidly permeable. Roots can penetrate to a depth of 60 inches or more.

These soils are used mainly for such irrigated crops as citrus, grapes, small grains, and potatoes.

Representative profile of Tujunga loamy sand, 0 to 5 percent slopes, about 100 feet east of Webster Road and about 200 feet northeast of Orange Street; SW¼ NE¼SW¼ sec. 3, T. 1 S., R. 3 W.; San Bernardino base line and meridian:

A1—0 to 6 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; single grained; loose when dry or moist, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; clear, smooth boundary.

C1—6 to 18 inches, pale-brown (10YR 6/3) coarse sand, brown (10YR 5/3) when moist; single grained; loose when dry or moist, nonsticky and nonplastic; few very fine roots; slightly acid; gradual, smooth boundary.

C2—18 to 60 inches, pale-brown (10YR 6/3) coarse sand, brown (10YR 5/3) when moist; single grained; loose when dry or moist, nonsticky and nonplastic; few very fine roots; slightly acid.

The A1 horizon is brown or grayish brown loamy sand, sand, or loamy coarse sand that is gravelly in places. It is generally single grained, but is massive in some places. This horizon is generally slightly acid, but it is neutral in a few spots. It ranges from 6 to 10 inches in thickness.

The C horizon is pale brown, very pale brown, or brown coarse sand, loamy sand, sand, and loamy coarse sand. Thin lenses of fine gravel are common. In small areas texture is gravelly loamy sand throughout, and in these areas the C horizon is about 15 to 30 percent gravel, by volume. In places there are a few cobbles below a depth of 44 inches. The soil is typically single grained, but in a few places the C horizon is massive. It is slightly acid in most places, is neutral in some places, and mildly alkaline below a depth of 40 inches in a few places.

Tujunga loamy sand, 0 to 5 percent slopes (TuB).—This nearly level to gently sloping soil is on broad, long alluvial fans. It has the profile described as representative of the series.

Included with it in mapping are areas of Tujunga gravelly loamy sand, 0 to 9 percent slopes, that generally are 10 to 20 acres in size. Also included are areas of Hanford sandy loam, 0 to 2 percent slopes.

Runoff is slow to very slow. The hazard of water erosion is slight, but the soil will blow if left unprotected. The hazard of soil blowing is moderate to high on bare soil. Available water capacity is 4 to 5 inches.

This soil is used for such irrigated crops as citrus, grapes, small grains, and pasture plants. Capability unit IIIe-4 irrigated.

Tujunga gravelly loamy sand, 0 to 9 percent slopes (TvC).—This nearly level to moderately sloping soil occurs on long, broad, smooth alluvial fans. It has a

profile similar to the one described as representative of the series, but the content of fine gravel, to a depth of 36 to 40 inches, is about 15 to 30 percent, by volume. Near Highland Avenue and Citrus Avenue north of 22d and Mountain Avenues, patches of this soil have a dark grayish-brown or dark-brown surface layer.

Included with this soil in mapping are areas of Soboba gravelly loamy sand. Also included are areas of Delhi fine sand.

Runoff is very slow to slow. Available water capacity is 3 to 4 inches. The hazard of erosion is slight because of the gravelly surface layer.

This Tujunga soil is used for irrigated small grains and pasture plants. It is a favored soil for lemons in the west end of the survey area north of Foothill Boulevard. Capability unit IVs-4 irrigated.

Vista Series

The Vista series consists of well-drained, steep soils that formed on foothills in the uplands in material weathered from granitic rock. Slopes are 30 to 50 percent. Elevation is 1,200 to 3,500 feet. Vegetation is chamise and annual grasses and forbs. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 61° to 65° F, and the frost-free season is 230 to 280 days.

In a representative profile, the surface layer is brown sandy loam or coarse sandy loam about 20 inches thick. The subsoil is yellowish-brown coarse sandy loam or sandy loam about 18 inches thick. Decomposed granitic rock is at a depth of 38 inches. Vista soils are typically slightly acid in the surface layer but become neutral with increasing depth.

These soils are moderately rapidly permeable. Their available water capacity is about 3 to 5 inches. Roots can penetrate to a depth of 24 to 40 inches.

These soils are used mainly for spring livestock grazing and watershed.

Representative profile of Vista sandy loam, 30 to 50 percent slopes, in an area of Vista-Rock outcrop complex, about three-fourths mile northwest of Rosendale Avenue in La Loma Hills and about three-fourths mile north of Riverside Freeway 395; NW¼NW¼ SW¼ sec. 6, T. 2 S., R. 4 W; San Bernardino base line and meridian:

A11—0 to 2 inches, brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) when moist; weak, medium, crumb structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; abrupt, smooth boundary.

A12—2 to 11 inches, brown (10YR 5/3) coarse sandy loam, dark brown (10YR 4/3) when moist; weak, medium, crumb structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; gradual, smooth boundary.

A13—11 to 20 inches, brown (10YR 5/3) coarse sandy loam, dark brown (10YR 4/3) when moist; weak, medium, granular structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid; clear, wavy boundary.

B21—20 to 29 inches, yellowish-brown (10YR 5/4) coarse sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many, very fine and fine, interstitial and tubular pores; slightly acid; gradual, wavy boundary.

B22—29 to 38 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish-brown (10YR 4/4) when moist; massive; hard, friable, nonsticky and nonplastic; few very fine roots; many, very fine, interstitial and tubular pores; neutral; abrupt, wavy boundary.

C—38 to 60 inches, brownish-yellow (10YR 6/6) decomposed granitic rock; neutral.

The A1 horizon is brown to dark grayish brown. In places it is weak, medium, subangular blocky in the lower part. This horizon is typically slightly acid, but it is medium acid in spots or even neutral. Thickness ranges from 12 to 20 inches but is about 20 inches in most places.

The B2 horizon is yellowish brown, brown, or strong brown fine sandy loam, sandy loam, or coarse sandy loam. In most places, it has weak, fine to medium, subangular blocky structure throughout, but in some places the lower part is massive. It ranges from 12 to 20 inches in thickness. In some places this horizon has a few thin clay films on ped faces or lining the tubular pores, but in other places the clay films occur as few to common, thin to moderately thick bridgings between mineral grains.

The C horizon is brownish-yellow or other varicolored decomposed granitic rock. Depth to weathered granite is 24 to 40 inches. Depth to hard rock is generally more than 60 inches but varies considerably within short distances.

Vista-Rock outcrop complex (Vr). —This steep complex is mainly on uplands. It is about 50 percent Vista sandy loam, 30 to 50 percent slopes, and 30 percent rock outcrops. Vista sandy loam and rock outcrops occur at random throughout each mapped area, but Vista sandy loam commonly occurs on the side slopes, and rock outcrops occupy the ridgetops and steeper parts of the landscape.

Included with this complex in mapping are about 135 acres south and southwest of Loma Linda near the Riverside County line where slopes are 10 to 15 percent and bedrock is not exposed. Also included are small scattered patches of a soil similar to this soil that has a subsoil of reddish-brown light sandy clay loam and small areas of San Timoteo loam, 30 to 50 percent slopes, eroded.

Runoff is medium to rapid, and the hazard of erosion is moderate.

This soil is used mainly for watershed but occasionally it is used for grazing of livestock in spring. Capability unit VIIe-1 dryland.

Use and Management of the Soils

In this section the system of capability grouping used by the Soil Conservation Service is discussed, the soils in each capability unit are described, and management suited to the soils in each unit is suggested. The estimated acre yields of principal crops and the Storie index rating of the soils are given. Use of the soils for wildlife, engineering purposes, and recreational development are discussed.

Capability Grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soils on their

farms. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations for range, for engineering, or for other purposes.

In the capability system, all kinds of soil are grouped at three levels: the class, the subclass, and the unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, The broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. (None in San Bernardino County, Southwestern Part.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w, s,* and *c,* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils.

Capability units in California are given Arabic numbers that suggest the chief kind of limitation responsible for placement of the soil in the capability class and subclass. For this reason, some of the units within the subclasses are not numbered consecutively, and their symbols are a partial key to some of the soil features. Except for class I, numerals are used to designate units within the classes and subclasses as follows:

0. A limitation caused by sand and gravel in the substratum that limits root penetration. (Not used in this soil survey.)
1. An actual or potential erosion hazard.
2. A limitation of wetness caused by poor drainage or flooding.
3. A limitation caused by slow or very slow permeability of the subsoil or substratum. (Not used in this soil survey.)
4. A limitation caused by coarse soil texture or excessive gravel.
5. A limitation caused by a fine or very fine textured surface layer. (Not used in this soil survey.)
6. A limitation caused by salt or alkali.
7. A limitation caused by cobbles, stones, or rocks.
8. A limitation caused by nearly impervious bedrock or hardpan within the effective rooting depth.
9. A limitation caused by low fertility or by toxicity. (Not used in this soil survey.)

Soils in capability classes V through VIII are given the unit 1.

Land resource areas

A land resource area is a broad geographic area that has a distinct combination of climate, soils, management needs, and cropping systems. The 48 conterminous States in the Nation have been divided into 156 land resource areas. Parts of one of these areas are in San Bernardino County, Southwestern Part.

This area and its number is Southern California Coastal Plain (19). Only small parts of Southern California Mountains (20) occur in this survey area. These areas are along the northern and eastern boundaries adjacent to the San Bernardino National Forest and are included with the discussion of the land resource area (19). Southern California Coastal Plain for convenience.

It is necessary to make assumptions that affect management in a land resource area if soils are to be placed consistently in capability units. In the paragraphs that follow, those land resource areas having parts within San Bernardino County, Southwestern Part, are described so that local farming can be related to the resource areas. Following the description of the resource area is a list of those conditions typical of the area that guided placement of the soils in capability classes and units.

Land Resource Area 19. — This land resource area makes up nearly all of the survey area. The soils formed under grasses and oaks in many of the areas. In some areas, however, the vegetation was chaparral and brush that had an understory of annual grasses and forbs. The soils in the southwestern part of the survey area are steep and are on complex marine and nonmarine formations. They are in upland areas that are hilly in many places. In other areas, steep soils on uplands formed in material weathered from granitic and schistose rocks. The areas are traversed by long, narrow, intermittent stream channels of the Santa Ana River and its major tributaries. Terraces occur near Timoteo Wash, Cajob Wash, Deer Creek, and Yucaipa Creek. In the middle part of the survey area are tracts near Chino, Ontario, Cucamonga, Fontana, San Bernardino, Redlands, and Mentone.

Throughout the area, elevation ranges from 600 to 3,000 feet. Summers are hot and dry. Winters are cool and moist. Precipitation ranges from 12 to 18 inches and varies from year to year. Supplemental irrigation is necessary for best continued year-round production. In the small included foothills and mountain areas along the northern and western boundaries, elevation ranges from about 3,000 to nearly 6,000 feet. Precipitation is 14 to 25 inches, and the growing season is 150 to 210 days.

The major properties that limit the use of these soils are coarse texture, steep slopes, pebbles, shallow depth to bedrock, cobblestones, or stones in the soil, and susceptibility to erosion.

The soils in Land Resource Area 19 are placed in capability units on the assumption that the following conditions exist:

1. The temperature generally is mild, and the frost-free period ranges from 230 to 310 days. Frosts occur locally, but protection is provided for crops that have a high cash value. Strong winds are likely to cause soil blowing on all sandy soils during the period when leveling is done for irrigation and until crops are established. Soil blowing is particularly a problem in the middle and western part of the Southwestern Part of San Bernardino County. Water erosion also is a hazard. Good conservation practices are used for control of soil blowing and to protect the soils from water erosion.
2. Irrigation water is available for most irrigable land from wells, local reservoirs, or sources outside the land resource area. Much of the acreage intensively cropped is under irrigation. Irrigation is generally being expanded as quickly as water becomes available. Reasonable precautions are taken to conserve water. Rainfall generally is adequate for leaching so that most soils are not affected by accumulations of salt. If the water supply is salty, drainage and leaching by rainwater are sufficient to minimize damage to crops that are sensitive to salt. In some parts near Mentone and Chino Hills, rainfall is adequate for dryland grains. Only here are the soils of this resource area classified on the basis of their capability for dryland crops as well as for irrigated crops.
3. Drainage and flooding generally are not a problem, though some areas require further control of flooding. Flooding along the major streams has been reduced through flood-control works. As a result flooding does not now affect management of the soils or the kind of cropping systems used.
4. Soils that contain salts and alkali are dark colored and somewhat poorly drained and occur on some level alluvial fans. In these areas irrigation water is generally expensive, and suitable outlets for extensive drainage systems are not readily available. No change in cost of water is expected in the near future. These soils are classified on the basis that no more than a limited amount of leaching and reduction of salts or alkali are possible.
5. A wide variety of the common orchard, field, vineyard, and fruit crops is grown.
6. A moderately high level of management is used.

Management by capability units

In the following pages, the capability units in San Bernardino County, Southwestern Part, are described and suggestion for use and management of the soils are given. Soil series names are mentioned in each capability unit, but this does not mean that all mapping units of the series are in that particular capability unit. To determine the soils in each unit, refer to the "Guide to Mapping Units" at the back of this soil survey.

In the following descriptions of the capability units, the available water capacity applies to the effective root zone or to the depth that plant roots generally penetrate.

General management practices. — All soils need green manure, crop residue, and other organic matter that help to maintain favorable soil structure, tilth, plant nutrients, and infiltration rates. Except for soils in orchards, crop rotation should be used to control the buildup of pests and disease and depletion of plant nutrients. This occurs if a single crop is grown for a number of years. If tillage is kept to a minimum, structure and infiltration are improved. All crop residue should be returned to the soil.

Nitrogen is needed for all crops but alfalfa and other legumes, which respond to phosphate fertilizer. Barnyard and poultry manures should be added if available. Orchards and vineyards may need special fertilizers or certain trace elements.

CAPABILITY UNIT I IRRIGATED

This capability unit consists of very deep, well-drained or somewhat poorly drained, nearly level soils of the Chino, Chualar, Grangeville, Hanford, San Emigdio, and Sorrento series. These soils are on broad alluvial fans, low terraces, and valley bottoms. Their surface layer is sandy loam, fine sandy loam, silt loam, or clay loam. The Grangeville and San Emigdio soils are fine sandy loam throughout, and the Hanford soil is sandy loam throughout. The Chualar and Sorrento soils are clay loam in the surface layer and subsoil, and the Chino soil is silt loam over silty clay loam.

Roots can penetrate to depths of 60 inches or more. Permeability is moderately rapid to moderately slow. The available water capacity is 7.5 inches or more.

The surface layer in these soils ranges from slightly acid to moderately alkaline. The lower layers tend to be more alkaline than the surface layer, and in some areas they are calcareous. Problems related to reaction or to lime are minor. The hazard of erosion is none to slight. In the Chino and Grangeville soils, the original drainage has been improved by pumping ground water to lower the water table, and wetness is no longer a problem. These are better than other soils in the survey area for farming.

All of the soils in this unit are well suited to all crops that are adapted to the climate.

Furrows, borders, or sprinklers can be used for irrigating, depending on the soil and the particular crop. If water is applied by borders or furrows, the soil needs to be smoothed or leveled to a uniform grade. Also, before deep leveling cuts are made, the soil depth should be checked. The length of runs for furrows and borders and the rate of application by sprinklers varies with the soil texture and the head of water. Enough water should be applied to wet the soil evenly to the rooting depth of the crop grown. A soil auger, shovel, or metal probe can be used to check the depth that water penetrates. Application should be timed so that the crop receives enough water but not too much.

CAPABILITY UNIT IIe-1 IRRIGATED

This capability unit consists of very deep, well-drained, gently sloping to moderately sloping soils of the Chualar, Garretson, Greenfield, Hanford, Oak Glen, Ramona, San Emigdio, and Sorrento series. These soils occupy alluvial fans and terraces throughout the southwestern and middle parts of the survey area. Their surface layer is coarse sandy loam, gravelly sandy loam, sandy loam, fine sandy loam, very fine sandy loam, or clay loam. Some of the soils have fairly uniform texture throughout the profile, but others have slight to moderate increases in clay content in the subsoil.

Roots can readily penetrate to a depth of 60 inches or more. Permeability is moderately rapid, moderate, or moderately slow. Available water capacity is more than 5.0 inches. The surface layer ranges from slightly acid to moderately alkaline. Some of the soils are calcareous throughout. Lime-induced chlorosis is not a problem, and the hazard of erosion is slight to moderate.

These soils are well suited to all crops that are suitable for the climate of the area. Good management is needed to keep erosion to a minimum.

Sheet and rill erosion can be controlled by applying irrigation water in borders or furrows placed across the slope. Water should be applied in proper amounts and in a way that does not erode the soil. The furrows should be of moderate length. When slopes are more than 2 percent, sprinkler irrigation is probably the best method to apply water and yet keep erosion to a minimum. The irrigation system should be designed so that water is applied at a rate no greater than the soil can take in.

CAPABILITY UNIT IIe-4 IRRIGATED

Hilmar loamy fine sand is the only soil in this capability unit. It is very deep, somewhat poorly drained, and nearly level. It is in areas near Ontario. Drainage has been improved by pumping ground water to lower the water table. The upper part of the underlying material is loamy sand, and the lower part is loam and thin strata of sandy loam and loamy sand.

Roots can penetrate to a depth of more than 60 inches. Permeability is rapid in the upper part of the profile and slow in the lower part. The available water capacity is about 6 to 7 inches. The soil is moderately alkaline throughout and strongly calcareous in the lower part. Slopes are less than 2 percent. The hazard of water erosion is slight, but the hazard of soil blowing is high.

Hilmar loamy fine sand is suited to all crops that are suited to the climate.

Protection for new seedings of alfalfa can be provided by seeding the alfalfa directly in standing grain stubble to keep soil disturbance from wind to a minimum. Stubble mulch left on the surface helps to keep the soil from blowing. All crop residue should be returned to the soil. Vegetation left on abandoned fields helps to keep the soil in place, especially during periods of high winds.

Windbreaks around farmsteads and field boundaries provide protection from the wind. Among the plants suitable for windbreaks are blue gum, dwarf blue gum, Arizona cypress, and Aleppo pine.

Irrigation water can be applied by a furrow, border, or sprinkler system. Sprinklers are well suited. The water should be applied more often than on soils in capability unit I irrigated, because the available water capacity of this soil is somewhat lower. Water is applied according to the crop needs. Because lower layers are slowly permeable layers, water should be applied with care to avoid causing a high water table, which once existed.

CAPABILITY UNIT IIIe-1 IRRIGATED

This capability unit consists of very deep, well-drained, gently sloping to strongly sloping soils of the Chualar, Greenfield, Hanford, Oak Glen, Ramona,

and San Emigdio series. These soils are on alluvial fans and terraces near the Chino Hills, Redlands, Loma Linda, and Yucaipa. Their surface layer is coarse sandy loam, sandy loam, or clay loam, and the material below it is gravelly sandy loam, sandy loam, or clay loam.

Roots can penetrate to a depth of 60 inches or more. Permeability is moderately rapid or moderately slow. The available water capacity ranges from 5 to 11 inches. These soils are slightly acid to moderately alkaline. Slopes range mostly from 9 to 15 percent. The hazard of erosion is slight to high.

Suitable irrigated crops for these soils are grapes, pasture plants, and small grains. The soils are suited to dryland small grain, such as barley and oats. All but the Oak Glen soil which has a shorter growing season are suited to citrus. The Oak Glen soil however, is suited to apple trees.

Irrigation water must be applied carefully for control of erosion. Furrows, if used, should be of moderate length. The volume of water should be small, and water should be applied in a way that does not erode the soil. On the Chualar, Greenfield, Hanford, Ramona, and San Emigdio soils, the furrows should be placed across the slope or on the contour. On the Chualar and Ramona soils, cuts made for terracing, leveling, or smoothing should be no more than 12 or 18 inches deep. The subsoil in some areas of these soils has less favorable texture or structure, and irrigation would be difficult in such areas. Sprinkler irrigation is probably the best method to apply water on the steeper soils and keep erosion to a minimum. The water should be applied at a rate no greater than the soils can take in.

CAPABILITY UNIT IIIe-4 IRRIGATED

This capability unit consists of very deep, somewhat excessively drained, nearly level to gently sloping soils of the Delhi and Tujunga series. These soils are on alluvial fans near Colton, the Ontario International Airport, and throughout the middle and eastern parts of the survey area. Their surface layer is loamy sand to fine sand. Below this is sand and coarse sand that extends to a depth of 60 inches or more.

Permeability of the underlying material is rapid. Available water capacity is about 4 to 5 inches. These soils are slightly acid throughout. Slopes are mostly 0 to 5 percent, and the hazard of soil blowing is moderate to high. Protection from both soil blowing and water erosion are needed. Vineyards are easily damaged by soil blowing.

These coarse-textured soils are better suited to citrus, grapes, alfalfa, pasture, and small grains than to most other crops. They are droughty and rapidly permeable. Frequent irrigation is needed but over-irrigation should be avoided. Sprinklers are well suited, but if borders or furrows are used, the runs should be short.

In many areas of Delhi soil, hummocks have been formed by the wind. These hummocks should be smoothed before irrigation water is applied. Protection for new seedings of alfalfa can be provided by seeding the alfalfa in standing grain stubble in the field. Returning all crop residue to the soil and, where feasible, leaving stubble mulch on the surface helps to keep the soil from blowing. Leaving weeds on abandoned fields helps to hold the soil in place during periods of high winds.

Windbreaks can be used around farmsteads and the boundaries of fields to provide protection from the wind. Among the plants suitable for windbreaks are bamboo, reedgrass (Arundo donax), Arizona cypress, aethel or evergreen tamarisk, and Aleppo pine.

CAPABILITY UNIT IIIe-8 IRRIGATED

Moderately deep, moderately well drained, gently sloping to moderately sloping soils of the Monserate series are in this unit. These soils are on alluvial fans south of Loma Linda. The surface layer is sandy loam or fine sandy loam, and the subsoil is clay loam that overlies a silica-indurated layer. Below is coarse sandy loam that extends to a depth of 60 inches or more. Permeability is moderately slow above the hardpan. The depth to which roots can penetrate is limited by a hardpan made up of silica-cemented layers. Roots can penetrate deeper than 30 to 40 inches only through fractures in the hardpan. The available water capacity is about 4 to 7 inches.

Suitable crops for irrigated areas are alfalfa, small grains, pasture plants, and other shallow-rooted plants. The hardpan should be ripped, blasted, or dug out before orchard crops or vineyards are established.

Because the depth of the soil is limited, irrigation water needs to be applied carefully. Frequent, light applications of water help prevent a perched water table and reduce aeration. Sprinklers are well suited. If leveling is done, deep cuts that expose the hardpan should be avoided. Cementation of the hardpan varies from place to place. In most places roots and water cannot penetrate the hardpan, but in some places they can penetrate it with difficulty. The soils can be made more permeable to water and effective depth increased by the use of ripping equipment to shatter the pan.

CAPABILITY UNIT IIIs-4 IRRIGATED

This capability unit consists only of Metz coarse sandy loam, 2 to 9 percent slopes. This soil is very deep and somewhat excessively drained. It is on alluvial fans near Redlands. The lower layers are gravelly sand.

Roots can penetrate to a depth of 60 inches. Permeability is rapid. The surface layer is mildly alkaline and strongly calcareous. Slopes range from 2 to 9 percent, and the hazard of erosion is slight. The hazard of soil blowing is slight to moderate in unprotected areas.

This soil is well suited to citrus, grapes, small grains, alfalfa, and pasture plants.

A sprinkler system of irrigation is well suited, but if borders or furrows are used, the runs should be short. In this way, the water is distributed evenly throughout the root zone. The soil is droughty; frequent irrigation is needed, but overirrigation should be avoided.

CAPABILITY UNIT IIIs-6 IRRIGATED

This capability unit consists only of Grangeville fine sandy loam, saline-alkali. Areas of this soil are near Loma Linda near the Tri-City Airport. This soil is very deep and somewhat poorly drained, but drainage has been improved in recent years by pumping that has lowered the water table over much of the area. The content of salts is moderate, but the soil is strongly affected by sodium. The lower layers are mottled, calcareous fine sandy loam.

Roots can penetrate to a depth of 60 inches or more. Permeability is moderately rapid. The available water capacity is about 7 to 9 inches. Reaction is strongly alkaline. Soluble salts and sodium salts occur throughout the profile. Slopes are less than 2 percent, and the hazard of erosion is slight.

If the content of salts is reduced by proper management, this soil is suited to most irrigated crops grown in the survey area. If the content of salts is not reduced, this soil is suited only to pasture of salt- and alkali-tolerant grass.

Irrigation can be done with furrows, borders, or sprinklers. Applying more water than the crops require leaches out excess salts and keeps the salt content to a minimum. In areas that have suitable outlets, tile drains may be needed to aid the leaching process. In addition to leaching for reclamation of this soil, soil amendments, such as gypsum or sulfur, are generally required for alkali reduction.

CAPABILITY UNIT IIIs-8 IRRIGATED

This capability unit consists only of Merrill silt loam. This soil is somewhat poorly drained. It is on alluvial fans near the Chino Hills. It is moderately deep to weakly cemented material that contains many extremely hard nodules, which are cemented with silica and lime. Below this material is calcareous gray loam that extends to a depth of 60 inches. Root penetration is limited by the weakly cemented material made up of silica and lime cemented layers. Roots can penetrate deeper than 25 to 40 inches only with difficulty. Permeability is slow, and the available water capacity is about 4 to 7 inches. This soil is moderately alkaline throughout. It is essentially free of harmful accumulations of salts and alkali. Slopes are 0 to 2 percent, and the hazard of erosion is slight. Drainage has been improved by pumping ground water for irrigation and as a result lowering the water table.

Suitable irrigated crops are alfalfa, small grains, and pasture plants. In places the cemented layer needs to be ripped, blasted, or dug out before orchards or vineyards can be established. Such action also increases permeability and the depth to which roots can penetrate.

Because the depth of the soil is limited, irrigation water should be applied carefully. Frequent light applications of water help prevent the formation of a perched water table and reduce aeration. Sprinklers are well suited. If soil is leveled, deep cuts that expose the cemented materials should be avoided. Cementation of the hardpan varies from place to place. In a few places roots and water cannot penetrate the hardpan, but in most places they can penetrate it along seams, cracks, and points of weakness.

CAPABILITY UNIT IVe-1 IRRIGATED

This capability unit consists of only Ramona sandy loam, 15 to 30 percent slopes, eroded. This is a very deep, well-drained, moderately steep soil mainly near Redlands and Dunlap. It has a surface layer of sandy loam and a subsoil of clay loam.

Roots can penetrate to a depth of 60 inches. Permeability is moderately slow. Available water capacity is 8 to 9 inches. Reaction is slightly acid in the surface layer and neutral below. Much of the area is eroded, and the hazard of erosion is moderate to high.

Sprinklers should be used for irrigating this soil. The sprinkler system should be designed so that the water is applied at a rate no greater than the soil can take in. In this way, excessive runoff is prevented and erosion is controlled.

CAPABILITY UNIT IVe-1 DRYLAND

This capability unit consists of shallow to very deep, somewhat excessively drained or well drained, strongly sloping to moderately steep soils of the Cieneba, Fontana, Nacimiento, and Oak Glen series. These soils are on alluvial fans, high terraces, and in uplands at an elevation higher than 800 feet. They are near the Chino Hills, San Bernardino National Forest, Yucaipa, and Redlands. Their surface layer is sandy loam, gravelly sandy loam, or clay loam. Some areas have some bedrock outcrops. In most places, roots can penetrate from a depth of about 22 inches to more than 60 inches, but not in the shallow Cieneba soils. Permeability is rapid, moderately rapid, or moderately slow. Available water capacity is generally about 4 to 9 inches, but in Cieneba soils it is about 1 to 3 inches. The surface layer and the material below are slightly acid to moderately alkaline. Slopes range from 9 to 30 percent, and the hazard of further erosion is slight to high.

The soils in this unit are suited to dryfarmed crops, such as barley and oats. The Oak Glen soil is suited to apples. Stubble mulching and tillage across the slopes are needed to protect the areas from sheet and rill erosion and to keep gullies from forming. Excess water can be safely removed from these soils and erosion reduced through use of diversions that have stabilized outlets. Soils in this unit need such practices as tillage, stubble mulching, contour stripcropping, and crop rotation.

CAPABILITY UNIT IVs-4 IRRIGATED

This capability unit consists of very deep, excessively drained and somewhat excessively drained, nearly level to moderately sloping soils of the Tujunga series. These soils are near San Bernardino and Upland and throughout the middle and northeastern parts of the survey area. Their surface layer is gravelly loamy sand. Below is very stony loamy sand or gravelly coarse sand that extends to depths of 60 inches or more. Roots penetrate to a depth of 60 inches or more.

Permeability in the subsoil is rapid or very rapid. Available water capacity is about 2 to 4 inches. The soils are slightly acid throughout. Slopes range from 0 to 9 percent, and the hazard of erosion is slight to moderate.

Suitable crops for irrigated areas are citrus, grapes, alfalfa, pasture plants, and small grains.

Because of their coarse texture, these soils are rapidly permeable and droughty. Frequent irrigation is needed, and sprinklers are well suited. Over irrigation should be avoided. If borders or furrows are used in applying irrigation water, the runs should be short. In this way, the soil profile is wetted at a more equal depth from the point of entry, in the check or furrow, to the end of the run.

CAPABILITY UNIT IVs-7 IRRIGATED

This capability unit consists only of Greenfield cobbly sandy loam, 5 to 15 percent slopes. This soil is very deep and well drained. It is near Crafton Hills.

Permeability is moderately rapid. The available water capacity is about 7 to 8 inches. The soil is slightly acid in the surface layer and subsoil and neutral in the substratum. The hazard of further erosion is slight.

Suitable crops for irrigated areas are citrus, vineyards, pasture plants, and small grains. Tillage is very difficult because of cobblestones on the surface.

Irrigation water should be applied by sprinklers or furrows across the slope or on the contour. Sprinkler irrigation is the most practical way to apply water in the steeper areas. Water should be applied at a rate no greater than the soils can take in.

CAPABILITY UNIT VIe-1 DRYLAND

This capability unit consists of moderately deep to very deep, well-drained, moderately steep to steep soils of the Alo, Fontana, Nacimiento, San Timoteo, and Soper series. These soils are mostly in the southwestern part of the survey area. The surface layer is gravelly sandy loam, gravelly loam, loam, clay loam, or clay. The underlying material is generally similar to the surface layer, but Soper soils have a subsoil of gravelly sandy clay loam. Some of the soils are gravelly, and in a few places bedrock crops out on the Fontana soil.

Roots can penetrate to a depth between 22 and 60 inches. Permeability of the subsoil is moderately rapid, moderate, moderately slow, or slow. Available water capacity is about 3 to 7 inches. Most soils in this unit are slightly acid to moderately alkaline. Slopes range from 15 to 50 percent. The hazard of further erosion is generally slight to moderate but is moderate to high on the San Timoteo soil.

These soils are suitable for seeded dryland pasture, spring grazing of livestock and wildlife habitat. Because they are steep, these soils are not suited to cultivated crops. Moderate grazing by livestock in spring maintains and improves the plant cover. Where range plants have been depleted by heavy grazing, fire, or other causes, the seeding of suited annual or perennial grasses and legumes improves the amount and quality of plants that provide forage and food for wildlife. Where there are heavy infestations of brush, the control of brush should precede seeding, but generally brush control is not needed, except on the San Timoteo soil.

CAPABILITY UNIT VIs-1 DRYLAND

This capability unit consists of very deep, excessively drained, gently sloping to moderately sloping soils of the Soboba series. These soils are on alluvial fans near Mentone and San Bernardino. Their surface layer is generally loamy sand or stony loamy sand. The underlying material is very stony sand. Roots penetrate to a depth of 60 inches or more. Permeability is very rapid, and the available water capacity is about 2 to 3 inches. The hazard of erosion is slight.

The soils in this unit are suited to spring grazing of livestock, some citrus crops, dryland seeded pasture, and wildlife habitat. Moderate grazing helps maintain and improve the plant cover. Where the plant cover has been depleted by heavy grazing or fire, brush control and seeding with suited annual or perennial grasses and legumes help improve the amount and quality of plants that provide forage and wildlife food.

CAPABILITY UNIT VIIe-1 DRYAND

This capability unit consists of shallow to moderately deep, excessively drained, somewhat excessively drained or well-drained, steep soils of the Cieneba, Crafton, Friant, Gaviota, Saugus, Soper, Tollhouse, and Vista series. These soils are mostly in the areas around Crafton Hills, Chino Hills, Loma Linda, and Redlands, but they are also in areas of foothills that border the San Bernardino National Forest and of mountains east of Yucaipa. Their surface layer is sandy loam, fine sandy loam, or gravelly loam. The underlying layer is generally similar to the surface layer, but the Soper soil has a subsoil of gravelly sandy clay loam. Exposed bedrock covers areas of the Cieneba, Friant, Crafton, and Gaviota soils.

Roots can penetrate to depths between 10 and 40 inches. Permeability ranges from moderately slow to rapid. Available water capacity is about 1 to 5 inches. Most soils in this unit are slightly acid to moderately alkaline. Slopes range from 30 to 50 percent, and the hazard of further erosion is moderate to high.

Because of the slopes, the moderate to high erosion hazard, rock outcrops, and shallowness, these soils are not suited to cultivated crops. They are used for spring grazing of livestock and wildlife habitat. Controlled grazing by livestock or wildlife helps to maintain and improve the plant cover. The cost of brush control and seeding to improve the range generally is not warranted because the soils are steep. Erosion control and fire protection are helpful in places.

CAPABILITY UNIT VIIIw-1 DRYLAND

Only Psamments and Fluvents, frequently flooded, are in this unit. They consist of sand and gravel and cobbles in channels of larger streams and their tributaries. The areas occur throughout the survey area. The soil material is excessively drained, though areas

are commonly flooded part of the year. Sorting, scouring, and redeposition of soil material occur annually. Fresh alluvium is continuously added and removed through flooding and streambank erosion. The areas are free of vegetation or are sparsely covered with annuals, brush, and willows. In places the vegetation is removed when the stream flow is heavy.

Areas of Psamments and Fluvents, frequently flooded, have no value for farming, but they are valuable as infiltration beds and for storing ground water. They are used as a source of commercial sand and gravel to be used for concrete aggregate, fill material, or for other engineering purposes.

Estimated Yields

This section gives estimated yields of the principal crops grown in San Bernardino County and some of the management practices used to obtain those yields. The estimates given in table 2 are mainly for irrigated crops. They are based on observations made by soil scientists, on comparisons with crops grown on similar soils, on information furnished by farmers, and on suggestions by crop specialists of the Federal Extension Service and the Soil Conservation Service. Data from Federal and county census records were also reviewed and considered. Only soils that are intensively cropped are listed in table 2.

Among the factors considered in making the estimates were the soil and climatic requirements of the crops, the probable crop yields and quality of the crop produced under the moderately high level of management commonly used in the survey area, and the probable productive life of perennial crops. Estimated yields for dryfarmed crops assume that rainfall is likely to vary widely from month to month and from year to year.

The crops listed in table 2 are those that are most commonly grown, and the yields shown are representative of the most extensive area of the various soils listed. Specialty crops grown intermittently on a small acreage are excluded. The yields in the table are averages, and in any one year actual yields may be higher or lower than those listed. The yields also do not apply to individual parcels of land, and care is needed in applying the ratings to a specific site.

Information provided in this section on yields and management practices will be most useful immediately and is based on existing technology. New developments in crop breeding, use of fertilizer, tillage, and control of insects and disease will make obsolete some information on management. Newer and better practices can always be substituted, and the State and Federal farm advisory services can provide the latest information available.

The management commonly practiced for most crops grown in the survey area includes proper preparation of the seedbed and control of weeds, diseases, insects, and pests. The better suited, more desirable varieties of crops are grown, and preparation of the seedbed, planting, harvesting, pruning, tillage, irrigation, and other management practices are done at the proper time and in the proper order.

The paragraphs that follow give the cropping sequence, the rate of planting and fertilization, and average amount of irrigation water needed for the crop yields indicated.

Citrus. — Navel and Valencia oranges, grapefruit, and lemons are planted at a rate of 90 to 100 trees per acre. Applications of 100 to 150 pounds of nitrogen[2] per acre are applied based on results indicated by leaf analysis. A foliar spray of zinc and manganese micronutrients is applied in the spring at rates indicated by leaf analysis. Iron deficiency in citrus is common on calcareous soils, and treatment is ordinarily applied according to the results of leaf analysis. In areas where the problem exists, overirrigation tends to accentuate iron deficiency.

For citrus, 5 to 6 inches of irrigation water per month is used during the peak season of water use. Irrigation water is applied by furrows and sprinklers. The irrigation method is determined by relief, soil texture, and other factors. Pest control for citrus requires intensive treatment. Weeds are controlled with herbicides or by cultivation.

Frost protection is needed during cold winter nights. Good air drainage is important in preventing the formation of cold-air pockets. Wind machines, orchard heaters, and warm irrigation water are used to raise the temperature above the point at which citrus freezes. Lemons begin freezing at 29.5° to 30.5°, oranges at 28.5° to 29.5°, and grapefruit at 28.0° to 29.0° F.

Apples. — Rome Beauty is the principal variety, but Red Delicious, Golden Delicious, and Gravenstein varieties are also grown. Nitrogen is applied at the rate of 70 to 90 pounds per acre per year. Organic fertilizers are often used. Micronutrients such as zinc are used when leaf analysis indicates the need. Irrigation water is applied at the rate of 5 inches per month during the growing season. Sprinkler and furrow irrigation systems are used. Sprinklers are recommended on sloping soils. A cover crop of Blando brome or Cucamonga brome seeded at a rate of about 10 pounds per acre helps to prevent the soils from eroding. Cultivation is held to a minimum, and mulch tillage is practiced. Weeds are controlled mainly by mowing and cultivation. Pests and plant diseases are controlled by spraying. The best commercial production is limited to elevations of about 3,500 feet or higher. Diversions and open drains are needed to control erosion from excess runoff and require annual maintenance. Apples are harvested between September 15 and November 30.

Wine grapes. — Grapes are grown only for wine in the survey area. Adapted varieties of red, white, and Zinfandel grapes are grown. Nearly all vineyards are irrigated. About 1.0 to 1.5 acre-feet of water is applied late in spring. A second irrigation is generally needed in dry years. Water is applied by portable sprinkler systems designed to accommodate intake rate of the soil.

Cover crops such as Cucamonga brome, planted at rates of 8 to 10 pounds of seed per acre, help protect the soils from soil blowing and water erosion during the winter and early spring months. Sweep-type culti-

[2] Fertilizer recommendations refer to the elemental form.

TABLE 2. — *Estimated average acre yields of the principal irrigated crops*

[Estimates are for the most extensive area of the listed soil, and only soils that are widely used for crops are listed. Dashes in grown extensively on the soil]

Soil	Oranges	Grapefruit	Lemons	Apples	Wine grapes	Alfalfa (green-chop)	Onions (dry)	Potatoes	Irri pas
	55-pound boxes	*52-pound boxes*	*55-pound boxes*	*40-pound boxes*	*Tons*	*Tons*[1]	*55-pound sacks*	*100-pound sacks*	*An unit-*
Chino silt loam	500–550	600–750			7.0–9.0	40–48	800–1000	450–500	
Chualar clay loam, 0 to 2 percent slopes	400–450	550–650				32–40			
Chualar clay loam, 2 to 9 percent slopes	350–400	450–550				24–32			
Chualar clay loam, 9 to 15 percent slopes	300–350	400–500				16–24			
Delhi fine sand	300–400	650–800	600–700		6.5–8.5	24–32	300–450	200 300	
Garretson very fine sandy loam, 2 to 9 percent slopes	450–500	800–900			7.0–9.0	32–40		350–400	
Grangeville fine sandy loam	450–500	600–700			6.5–8.5	40–48	800–1000	450–500	
Grangeville fine sandy loam, saline-alkali						[3]16–24			
Greenfield sandy loam, 2 to 9 percent slopes	500–550	700–850	650–750		7.0–9.0	32–40		350–450	
Greenfield sandy loam, 9 to 15 percent slopes	450–500	650–700	600–700		6.0–8.0	24–32			
Greenfield cobbly sandy loam, 5 to 15 percent slopes	350–450	600–650	550–600		6.0–7.0	16–24			
Hanford coarse sandy loam, 2 to 9 percent slopes	450–500	800–900	650–750		7.0–9 0	24–32	650–800	350–400	
Hanford coarse sandy loam, 9 to 15 percent slopes	400–450	750–850	600–650		6.5 8.5	16–24			
Hanford sandy loam, 0 to 2 percent slopes	500–550	900–1000	750–800		7.0–9.0	32–40	800–1000	450–500	
Hilmar loamy fine sand	350–450	650–750			7.0–9.0	24–32	350–500	250–300	
Merrill silt loam						[4]24–32			
Metz coarse sandy loam, 2 to 9 percent slopes	300–400	750–850	650–750		6.0–8.0	24–32		350–400	
Monserate sandy loam, 2 to 9 percent slopes						[4]20–28			
Oak Glen sandy loam, 2 to 9 percent slopes				550–600		20–28			
Oak Glen gravelly sandy loam, 9 to 15 percent slopes				450–550		16–20			
Oak Glen gravelly sandy loam, 15 to 30 percent slopes				400–500					
Ramona sandy loam, 2 to 9 percent slopes	450–500	600–700	650–750		6 0–8.0	24–32		300–350	
Ramona sandy loam, 9 to 15 percent slopes	350–450	500–600	600–650		5.5–7.5	16–24			
Ramona sandy loam, 15 to 30 percent slopes, eroded	300–400	450–550	500–600		4.0–5 5				
San Emigdio sandy loam, 9 to 15 percent slopes	350–450	650–750	500–600		6.0–8.0	24–32			
San Emigdio gravelly sandy loam, 2 to 9 percent slopes	350–400	700–800	500–600		6.5–8 5	24–32		250–350	
San Emigdio fine sandy loam, 0 to 2 percent slopes	450–500	800–900	650–750		7.0–9.0	40–48	450–500		
San Emigdio fine sandy loam, 2 to 9 percent slopes	400–450	750–850	550–650		7.0–9.0	32–40	350–400	400–450	
Soboba gravelly loamy sand, 0 to 9 percent slopes	300–350	550–650	600–700		4.0–6.0				

TABLE 2.—*Estimated average acre yields of the principal irrigated crops*—Continued

Soil	Oranges	Grapefruit	Lemons	Apples	Wine grapes	Alfalfa (greenchop)	Onions (dry)	Potatoes	Irrigated pasture	Oat hay	Barley
	55-pound boxes	*52-pound boxes*	*55-pound boxes*	*40-pound boxes*	*Tons*	*Tons*[1]	*55-pound sacks*	*100-pound sacks*	*Animal-unit-months*[2]	*Tons*	
Soboba stony loamy sand, 2 to 9 percent slopes	250–300	400–500	500–600		3.5–5.5						
Sorrento clay loam, 0 to 2 percent slopes	350–450	550–650				32–40			16–20	2.5–3.5	12–15
Sorrento clay loam, 2 to 5 percent slopes	350–450	500–550				32–40			16–20	2.0–3.0	11–14
Tujunga loamy sand, 0 to 5 percent slopes	300–400	650–800	650–750		7.0–8.5	16–24	300–450	200–300	8–12	1.0–2.0	4–8
Tujunga gravelly loamy sand, 0 to 9 percent slopes	250–300	550–650	600–650		6.0–7.0	16–20		200–250	6–10	1.0–2.0	4–8

[1] Can be converted to air-dry weight tons alfalfa per acre divided by factor of 4.

[2] Animal-unit-months is a term used to express the carrying capacity of pasture. It is the amount of forage or feed required to maintain one animal unit (1 cow, 1 horse, 5 sheep, or 5 goats) or 1,000 pounds of live weight for a period of 30 days. The ratings for irrigated pasture are based on: (1) a 9 month growing season, (2) applying nitrogen and phosphorus during the year according to the recommended local practice, (3) rotating grazing and withholding grazing when the soil is wet, (4) mowing when necessary to kill weeds and prevent bunching of grass, and (5) use of dragging to scatter manure.

[3] Leaching or soil amendments needed.

[4] A hardpan in the soil may need shattering.

vators used in the spring leave a protective mulch residue from the cover crop on the soil surface. In winter vine prunings are shredded and left on the soil as a protection against wind erosion. Soil protection is required during the season of strong Santa Ana winds. Many growers do not fertilize wine grapes, but some response can be acquired by applying about 50 pounds of nitrogen per acre annually.

Alfalfa. — Nearly all the alfalfa grown in the survey area is harvested as greenchop and sold to local dairymen. Only disease and insect resistant varieties give profitable yields. A typical cropping sequence consists of 2 to 3 years of alfalfa, 1 year of small grain, and 1 year of silage. The alfalfa seed is inoculated with nitrogen-fixing bacteria before it is seeded at a rate of 20 to 25 pounds per acre. Alfalfa requires 80 to 100 pounds of phosphorus per acre annually. On sandy soils application of 3 to 5 tons of poultry manure or 10 to 12 tons of barnyard manure is common practice. For alfalfa, 5 to 6 acre-feet of irrigation water are used annually. Irrigation water is applied by a border or a sprinkler system.

Onions. — A suitable cropping sequence consists of 2 to 4 years of alfalfa, 1 year of small grain and silage, and 2 years of onions. Yellow, white, or red onion seed is planted at a rate of 4 to 6 pounds per acre. An annual application of 95 to 120 pounds of nitrogen, 40 to 50 pounds of phosphorus, and 40 to 50 pounds of potassium per acre is required on most soils for profitable yields. On sandy soils, use of 3 to 5 tons of manure per acre annually is recommended. For onions, 2.5 to 3.0 feet of irrigation water is used annually.

Potatoes. — Most potatoes are grown in the spring. A typical cropping sequence for coarse sandy loam to very fine sandy loam consists of 2 years of potatoes, 1 year of small grain, and 2 or 3 years of alfalfa. The cropping sequence for deep sandy soils is 1 year of potatoes, 1 year of small grain, and 2 to 3 years of alfalfa. Certified seed potatoes of the White Rose or Irish Red variety are planted between March 15 and April 15 at a rate of 1,500 to 2,000 pounds of treated seed per acre. Fertilizer is applied at the time of planting or as a side dressing, according to the results of soil tests. From 100 to 150 pounds of nitrogen, 40 to 80 pounds of phosphorus, and 80 pounds of potassium per acre are ordinarily used annually. Potatoes grown on sandy soils respond well to 3 to 5 tons of poultry or barnyard manure per acre per year. For potatoes, 3.5 to 4.0 feet of irrigation water is used annually.

Irrigated pasture. — Locally suited varieties of grasses and legumes are seeded at a rate of 15 to 20 pounds per acre on most soils. Sandy soils are best adapted to 2 to 4 pounds of alfalfa seed and 15 bushels of Coastal bermudagrass sprigs or 3 pounds of giant bermudagrass seed per acre. A suitable cropping sequence consists of 5 to 7 years of pasture, 1 year of small grain or silage, and 2 years of row crops. Most soils require 100 to 150 pounds of nitrogen per acre each year. Phosphorus, when needed, is indicated by soil tests. It is used at a rate of 25 pounds per acre annually. Large amounts of cow manure, 10 to 20 tons per acre, are commonly used on pastures owned by dairy operators. For pastures, 4 to 6 acre-feet of irri-

gation water is used each year. Irrigation is by border or sprinklers.

Dryfarmed oat hay and barley. — A suitable cropping sequence is 1 year of oats or barley and 1 year of fallow. After treatment with a fungicide, seed is planted at a rate of 50 to 75 pounds of clean Kanota oat seed or CM67 barley seed per acre. In years when rainfall is favorable, oats and barley respond if 20 to 40 pounds of nitrogen per acre is applied, but response to fertilizer is not certain.

Storie Index Rating[3]

The soils of the area are listed in table 3 and rated according to the Storie Index (*13*, *14*). This Index expresses numerically the relative degree of suitability of a soil for general intensive farming as it exists at the time of evaluation. The rating is based on soil characteristics only and is obtained by evaluating such

[3] By GORDON L. HUNTINGTON, lecturer and soil specialist, University of California, Davis.

TABLE 3. — *Storie index ratings of the soils*

Map symbol	Soil	Soil rating factors				Index	Grade	Limitation in factor X
		A	B	C	X			
AaF	Alo clay, 30 to 50 percent slopes	75	60	40	90	16	5	
Cb	Chino silt loam	95	100	100	90	86	1	Drainage altered.
CkA	Chualar clay loam, 0 to 2 percent slopes	90	85	100	100	77	2	
CkC	Chualar clay loam, 2 to 9 percent slopes	90	85	97	100	74	2	
CkD	Chualar clay loam, 9 to 15 percent slopes	90	85	90	80	55	3	
CnD	Cieneba sandy loam, 9 to 15 percent slopes	40	95	90	95x80	26	4	Nutrient level.
Cp	Cieneba-Friant sandy loams	25	95	40	95x80	7	6	Nutrient level
Cr	Cieneba-Rock outcrop complex	40	50	40	95x80	6	6	Nutrient level.
Cs2	Crafton-Rock outcrop complex, eroded	60	65	40	80	12	5	Sheet and rill erosion.
Db	Delhi fine sand	100	65	100	95	62	2	Nutrient level.
FoE	Fontana clay loam, 15 to 30 percent slopes	80	85	75	100	51	3	
FoF	Fontana clay loam, 30 to 50 percent slopes	80	85	40	100	27	4	
Fr	Friant-Rock outcrop complex	35	70	40	100	10	5	
GaC	Garretson very fine sandy loam, 2 to 9 percent slopes	100	100	95	100	95	1	
Go	Gaviota-Rock outcrop complex	35	80	40	95x80	8	6	Nutrient level.
Gr	Grangeville fine sandy loam	100	100	100	90	90	1	Drainage altered.
Gs	Grangeville fine sandy loam, saline-alkali	100	100	100	90x20	18	5	Drainage altered; saline-alkali effect.
GtC	Greenfield sandy loam, 2 to 9 percent slopes	95	95	95	80	69	2	
GtD	Greenfield sandy loam, 9 to 15 percent slopes	95	95	90	75	61	2	
GuD	Greenfield cobbly sandy loam, 5 to 15 percent slopes	95	60	90	80	41	3	
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes	100	90	95	100	86	1	
HaD	Hanford coarse sandy loam, 9 to 15 percent slopes	100	90	90	80	65	2	
HbA	Hanford sandy loam, 0 to 2 percent slopes	100	95	100	100	95	1	
Hr	Hilmar loamy fine sand	95	90	100	90	77	2	Drainage altered
Me	Merrill silt loam	80	100	100	90	72	2	Drainage altered.
MgC	Metz coarse sandy loam, 2 to 9 percent slopes	95	90	95	95	77	2	Nutrient level.
MoC	Monserate sandy loam, 2 to 9 percent slopes	40	95	95	95x80	27	4	Nutrient level.
NaE	Nacimiento clay loam, 9 to 30 percent slopes	80	85	80	90	49	3	
NaF	Nacimiento clay loam, 30 to 50 percent slopes	80	85	40	80	22	4	
OaC	Oak Glen sandy loam, 2 to 9 percent slopes	100	95	95	100	90	1	
OgD	Oak Glen gravelly sandy loam, 9 to 15 percent slopes	100	60	90	100	54	3	
OgE	Oak Glen gravelly sandy loam, 15 to 30 percent slopes	100	60	75	100	45	3	
Ps	Psamments and Fluvents, frequently flooded					<10	6	
RmC	Ramona sandy loam, 2 to 9 percent slopes	85	95	97	95x80	60	29	Nutrient level
RmD	Ramona sandy loam, 9 to 15 percent slopes	85	95	90	95x80	55	3	Nutrient level.
RmE2	Ramona sandy loam, 15 to 30 percent slopes, eroded	85	95	75	95x70	40	3	Nutrient level; sheet, rill, and gully erosion
SaD	San Emigdio sandy loam, 9 to 15 percent slopes	100	100	90	80	72	2	
SbC	San Emigdio gravelly sandy loam, 2 to 9 percent slopes	100	70	95	100	67	2	
ScA	San Emigdio fine sandy loam, 0 to 2 percent slopes	100	100	100	100	100	1	
ScC	San Emigdio fine sandy loam, 2 to 9 percent slopes	100	100	95	100	95	1	
SgF2	San Timoteo loam, 30 to 50 percent slopes, eroded	65	100	40	75	19	5	Sheet and rill erosion; occasional gullies.
ShF	Saugus sandy loam, 30 to 50 percent slopes	80	95	25	70	7	6	
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	80	40	95	95	29	4	Nutrient level.
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	80	30	95	95	22	4	Nutrient level
SrE	Soper gravelly loam, 15 to 30 percent slopes	70	80	75	95x80	32	4	Nutrient level
SrF	Soper gravelly loam, 30 to 50 percent slopes	70	100	40	95x75	20	4	Nutrient level.
StA	Sorrento clay loam, 0 to 2 percent slopes	100	85	100	100	85	1	
StB	Sorrento clay loam, 2 to 5 percent slopes	100	85	97	100	82	1	
ToF	Tollhouse sandy loam, 30 to 50 percent slopes	40	95	40	95x80	12	5	Nutrient level.
TuB	Tujunga loamy sand, 0 to 5 percent slopes	95	80	97	95	70	2	Nutrient level.
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes	95	40	95	95	34	4	Nutrient level.
Vr	Vista-Rock outcrop complex	70	60	50	95x80	16	5	Nutrient level.

factors as soil depth, texture of the surface soil, density of subsoil, drainage, salts and alkali, and relief. Other factors, such as availability of water for irrigation, climate, and distance from markets, might determine the desirability of growing certain plants in a given locality but are not considered. The Index, in itself, therefore, should not be considered as a direct index of land value. Where economic factors are known to the user, however, the Storie Index provides additional objective information for land tract value comparisons.

Four general factors are considered in the index rating. These factors are (A) the characteristics of the soil profile and soil depth, (B) the texture of the surface layer, (C) dominant slope of the soil, and (X) other factors more readily subject to management or modification. In this area the X factors include drainage, salts and alkali, general nutrient level of the soil, and erosion. Each of these four general factors is evaluated on the basis of 100 percent. A rating of 100 percent expresses the most favorable, or ideal, condition, and lower percentage ratings are given for conditions that are less favorable for crop production.

The index rating for a soil is obtained by multiplying the four factors, A, B, C, and X; thus, any factor may dominate or control the final rating. For example, a soil such as Grangeville fine sandy loam, saline-alkali, may have an excellent permeable profile justifying a rating of 100 percent for factor A, excellent texture of the surface soil justifying 100 percent for factor B, and a smooth, nearly level surface justifying 100 percent for factor C. A slight drainage problem and a high accumulation of salts or alkali result in a rating of 90x20 or 18 percent of factor X. Multiplying these four ratings gives an index rating of 18 for this soil. The high accumulation of salts or alkali would dominate the quality of the soil, render it unproductive for crops, and justify the low index rating of 18. In time, however, this soil may be partly or totally reclaimed. At that time the Storie Index should be reevaluated to reflect the changed conditions.

Soils are placed in grades according to their suitability for general intensive farming as shown by their Storie Index ratings. The six grades and their range in index ratings are as follows:

	Index rating
Grade 1	80 to 100
Grade 2	60 to 80
Grade 3	40 to 60
Grade 4	20 to 40
Grade 5	10 to 20
Grade 6	Less than 10

Soils of grade 1 are excellent and are well suited to general intensive farming. Grade 2 soils are good and are also well suited to farming, but they are less desirable than grade 1 soils. Grade 3 soils are only fairly well suited, grade 4 soils are poorly suited, and grade 5 are very poorly suited. Grade 6 consists of soils and land types that are not suitable for farming.

Use of the Soils for Range

About 50,000 acres in San Bernardino County, Southwestern Part, are used for grazing livestock. The soils in range in the survey area are in the Alo, Cieneba, Friant, Crafton, Fontana, Gaviota, Nacimiento, Oak Glen, San Timoteo, Saugus, Tollhouse, and Vista series. The acreage of range is decreasing, and the intensity of use varies widely from year to year. Much of the range is only for such incidental use as spring grazing for brief periods. The main livestock enterprise is maintained that consists of cow-calf operations in which the breeding herd is continuously at weaning age.

Range vegetation in San Bernardino County, Southwestern Part, is made up mostly of annual grasses in the higher open areas of oak and grass and pine and grass. Brushy chaparral grows in many of the upland areas.

The original plant community consisted of open stands of grass dominated by perennial grass or of trees that were either scattered or in slightly dense woodland stands. These stands consisted of oak and an understory of perennial grasses or chaparral dominated by such shrubs as caenothus, scrub oak, chamise, and manzanita. Jeffrey pine and other pines grow in higher areas of open grass. The perennial grasses and forbs growing in areas of open grass are similar to those in the understory of chaparral.

Changes have taken place in the original plant cover. Intensive cultivation has replaced most of the grazing. Fire and grazing have caused the brush to increase and to invade the grass. Annuals have increased as the perennial bunchgrasses have decreased. As a result, the grasses and shrubs that provide more desirable forage for livestock have decreased and the less desirable or undesirable plants have increased.

The Alo, Fontana, Gaviota, Nacimiento, and San Timoteo soils are mainly in the Chino Hills. Here the plant cover is mainly grass or grass and forbs. Heavy stands of annual grasses such as wild oats and burclover and lesser amounts of soft chess, ryegrass, and cutleaf filaree are grown in the Alo, Fontana, Nacimiento, and San Timoteo soils. Under heavy use, such plants as ripgut brome, redbrome, poverty fescue, and weedy annuals are dominant. In areas of Gaviota soils, the plant cover tends to be a rather dense stand of chamise brush and a thin understory of soft chess, wild oats, cutleaf filaree, and other annuals.

The Cieneba, Friant, Saugus, and Vista soils occupy foothills in the southern, northern, and western parts of the survey area. Here the plant cover is an open to dense stand of brush and California sagebrush, flattop buckwheat, and white and black sage that are predominantly in areas at lower elevation. These shrubs intermingle with and are replaced by chamise, manzanita, and other chaparral plants. The understory is soft chess, wild oats, ryegrass, cutleaf filaree, and other annuals. Needlegrass and other perennial grasses occur. The herbaceous understory is sparse. If depleted by fire or heavy grazing, such plants as red

brome, nitgrass, poverty fescue, popcorn flower, and annual lupines predominate. In some areas where fire has depleted the vegetation, almost pure stands of chamise but no herbaceous understory grow.

The Tollhouse, Oak Glen, and Crafton soils are in areas at higher elevation. The plant cover is woodland and grass as well as scattered oak trees and a few patches of open to dense stands of oak. A few Jeffrey pines grow near the top of the mountains. Among the dominant plants are wild oats, soft chess, ryegrass, cutleaf filaree, and annual clovers. Among the perennial grasses are needlegrass, deergrass, pine bluegrass, and blue wildrye. With continuous heavy grazing, such plants as ripgut brome, red brome, nitgrass, lupine, and woody annuals increase. If depleted by fire, such brushy plants as flattop buckwheat, white sage, black sage, and chamise replace the grass.

For more information on the management of these soils as range, see the section "Management by Capability Units."

Engineering Uses of the Soils[4]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth of the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who:

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

[4] WARREN D. BENNETT, civil engineer, Soil Conservation Service, assisted in preparation of this section.

Most of the information in this section is presented in tables 4 and 5. Table 4 shows the estimated soil properties significant in engineering, and table 5 gives interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 4 and 5, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science that is not used in engineering. The Glossary defines many of these terms commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*2*) used by the SCS engineers, Department of Defense, and others, and the AASHTO system adopted by the American Association of State Highway and Transportation Officials (*1*).

In the Unified system, soils are classified according to particle size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL-ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The estimated classification, without group index numbers, is given in table 4 for all soils mapped in the survey area.

TABLE 4.—*Estimated soil properties*

[Absence of information indicates that a determination was not made or that it would not be applicable. The symbol > means made up of two or more kinds of soil. The soils in such mapping units have different properties and limitations and for this reason

Soil series and map symbols	Depth to bedrock or hardpan	Depth from surface of typical profile	(Typical profile) USDA texture	Classification		Coarse fraction greater than 3 inches	Percentage less than 3 in passing sieve—	
				Unified	AASHTO		No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Inches*						
Alo: AaF	2–3	0–36	Clay	CH, CL	A–7		100	100
		36	Shale and sandstone.					
Chino. Cb	>5	0–16	Silt loam	ML, CL-ML	A–4		100	100
		16–60	Silty clay loam	CL	A–6		100	100
Chualar· CkA, CkC, CkD	>5	0–36	Clay loam	CL	A–6		100	100
		36–60	Loam	CL, CL-ML	A–4		100	100
*Cieneba: CnD, Cp, Cr	1–1½	0–14	Sandy loam	SM	A–2	0–10	90–100	90–100
For properties of Friant soils in Cp, refer to Friant series.		14	Weathered granitic rock.					
Crafton: Cs2	1½–3	0–26	Sandy loam	SM	A–2	0–15	80–100	75–100
		26	Weathered micaceous schist.					
Delhi: Db	>5	0–18	Fine sand	SM	A–2		100	95–100
		18–60	Sand	SP–SM or SW–SM	A–3		100	90–100
Fontana. FoE, FoF	2–3	0–28	Clay loam, some shale fragments.	CL	A–6	0–10	85–100	70–95
		28	Weathered fractured shale.					
Friant: Fr	1–1½	0–14	Fine sandy loam	SM	A–4		95–100	80–95
		14	Hard mica schist.					
Garretson: GaC	>5	0–7	Very fine sandy loam	ML	A–4		100	100
		7–28	Loam	CL–ML, CL	A–4		100	100
		28–34	Fine sandy loam	SM	A–4		95–100	90–100
		34–42	Gravelly sandy loam	SM	A–2		65–90	65–80
		42–60	Loam	CL–ML, CL	A–4		100	100
Gaviota: Go	1–1½	0–15	Fine sandy loam	SM	A–4	0–5	95–100	80–95
		15	Hard sandstone.					
Grangeville:								
Gr	>5	0–60	Fine sandy loam	SM	A–4		100	100
Gs		0–60	Fine sandy loam	SM	A–4		100	100
Greenfield:								
GtC, GtD	>5	0–16	Sandy loam	SM	A–2		95–100	90–100
		16–50	Fine sandy loam	SM	A–4		95–100	85–100
		50–60	Sandy loam	SM	A–2		95–100	90–100
GuD	>5	0–16	Cobbly sandy loam	SM	A–2	25–40	90–100	85–95
		16–50	Fine sandy loam	SM	A–4		95–100	85–100
		50–60	Sandy loam	SM	A–2		95–100	90–100
Hanford: HaC, HaD, HbA	>5	0–60	Sandy loam	SM	A–2		100	90–100
Hilmar: Hr	>5	0–23	Loamy fine sand and loamy sand.	SM	A–2			95–100
		23–60	Stratified loam.[2]	CL–ML, CL	A–4		100	100
Merrill. Me	2–3½	0–25	Silt loam	CL–ML or ML	A–4		100	95–100
		25–43	Loam that is 25 to 50 percent extremely hard lime nodules.	GM	A–4 or A–2	0–5	40–70	35–65
		43–60	Loam	CL–ML or CL	A–4		100	95–100
Metz: MgC	>5	0–19	Coarse sandy loam	SM	A–2		95–100	90–100
		19–60	Gravelly sand and loamy coarse sand.	SM	A–1		70–80	55–75
Monserate: MoC	2½–3	0–10	Sandy loam	SM	A–2, A–4		100	100
		10–30	Clay loam	CL	A–6		100	100
		30–45	Indurated hardpan					
		45–60	Coarse sandy loam	SM	A–2		95–100	90–100

significant in engineering

more than; the symbol < means less than. An asterisk in the first column indicates that at least one mapping unit in the series is it is necessary to follow carefully the instructions for referring to the other series given in the first column of this table]

Percentage less than 3 in. passing sieve—Cont.		Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 40 (0.42 mm)	No. 200 (0.074 mm)							
		Percent		*Inches per hour*	*Inches per inch of soil*	*pH*	*Mmhos per centimeter at 25°C*	
90–100	75–90	40–60	25–40	0.06–0.2	0 15–0.17	5.6–9.0	0–2	High.
90–100	70–85	20–35	0–10	0 2–0.6	0.17–0.19	7.9–8 4	0–2	Low.
95–100	75–85	25–40	15–30	0.2–0.6	0.17–0.20	7.9–8.4	2–4	Moderate.
90–100	70–80	30–40	10–20	0.2–0.6	0 17–0.18	6.1–8 4	0–2	Moderate.
85–95	60–75	20–30	5–10	0.6–2.0	0.15–0.17	7.9–8.4	0–2	Low.
50–65	25–35	[1]NP	[1]NP	6.0 20	0.14–0.15	6.1–7.3		Low.
50–65	25–35	NP	NP	2.0 6.0	0.10–0.12	5.6 -7.3		Low.
60–85	15–25	NP	NP	6.0–20	0.07 -0.09	5.6–7.3		Low.
50–70	5–10	NP	NP	6.0 20	0.06–0.08	6.1–7 8		Low.
65–85	55–75	30–40	10–20	0.2–0.6	0.18–0.20	6.1–8.4	0–2	Moderate.
70–85	35–50	NP	NP	2.0–6.0	0 10–0.14	5.6–7.3		Low.
85–95	65–80	20–35	NP–5	2.0–6.0	0.14–0.16	6.6–7.8	0–2	Low.
85–95	60–75	20–30	5–10	0.6–2.0	0.15–0.17	7.9–8.4	0 2	Low.
60–75	40–50	NP	NP	0.6–2.0	0.12–0.14	7.4–7.8	0–2	Moderate.
50–60	25–35	NP	NP	2 0–6.0	0.09–0.10	7.9–8.4	0–2	Low.
85–95	60–75	20 30	5–10	0.6–2.0	0 15–0.17	7.9 8.4	0–2	Low.
65–75	35–50	NP	NP	2.0–6 0	0.11 0.14	6.1 -7.3		Low.
65–85	35–50	5–20	0–5	2.0–6.0	0.12–0.14	7.9–9.0	2–4	Low.
65–85	35–50	5–20	0–5	2.0–6.0	0.12–0.14	8.8–9.0	8–16	Low.
60–75	20–30	NP	NP	2.0–6.0	0.11–0.13	6.1–7.3	0–2	Low.
70–85	35–50	15–25	0–5	2.0–6.0	0.13–0.15	6.1–7.3	0–2	Low.
60–75	20 30	NP	NP	2 0–6.0	0.11–0.13	6.6–7.8	0–2	Low.
60–75	20–30	NP	NP	2.0–6.0	0.10–0.12	6.1–7 3		Low.
70–85	35–50	15–25	0–5	2.0–6.0	0.13–0.15	6.1–7.3		Low.
60–75	20 30	NP	NP	2.0–6.0	0.11–0.13	6.6–7.8	0–2	Low.
60–75	20–30	NP	NP	2.0–6 0	0.12–0.13	6.1–7.8	0–2	Low.
60 85	15 30	NP	NP	6.0–20	0.07–0.10	7.9–8.4	0–2	Low.
85–95	50–60	15–25	5–10	0.06–0.2	0.15–0.17	7.4–9.0	0–2	Low.
90–100	75–90	20–35	5–10	0 6–2.0	0.14–0.17	7.9–8.4	0–2	Low.
30–55	25–40	20–30	NP–5	0 06–0 2	0.01–0.03	7.9–9.0	0–2	Low.
85–95	65–80	15–25	5–10	0.6–2.0		7.9–9.0	0–2	Low.
40–60	25–35	NP	NP	2.0–6.0	0.08–0.09	7.4–7.8	0–2	Low.
40–50	15 25	NP	NP	6.0–20	0.04–0.06	7.4 -8.4	0–2	Low.
60–80	25–50	NP	NP	2.0–6.0	0.10–0.15	6.1–7.3	0–2	Low.
90–100	70–80	25–40	15–25	0.2–0.6	0.16–0.20	6.6–7.8	0–2	Moderate.
40–60	25–35	NP	NP	<0 06 2.0–6.0		7.4–8.4	0–2	Low.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock or hardpan	Depth from surface of typical profile	(Typical profile) USDA texture	Classification		Coarse fraction greater than 3 inches	Percentage less than 3 in. passing sieve—	
				Unified	AASHTO		No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Inches*						
Nacimiento: NaE, NaF	2–3	0–28	Clay loam	CL	A–6		100	95–100
		28	Weathered sandstone.					
Oak Glen:								
OaC	>5	0–20	Sandy loam	SM	A–2		95–100	90–100
		20–60	Gravelly sandy loam	SM	A–2		65–90	55–75
OgD, OgE	>5	0–60	Gravelly sandy loam	SM	A–2		65–90	55–75
Psamments and Fluvents, frequently flooded: Ps. Properties are too variable to be estimated.								
Ramona: RmC, RmD, RmE2	>5	0–23	Sandy loam and fine sandy loam.	SM	A–2 or A–4		100	95–100
		23–54	Loam, clay loam and sandy clay loam.	SC or CL	A–6		100	95–100
		54–60	Sandy loam	SM	A–2		95–100	95–100
San Emigdio:								
SaD, ScA, ScC	>5	0–60	Fine sandy loam	SM	A–4		100	100
SbC	>5	0–16	Gravelly sandy loam	SM	A–2		75–90	60–75
		16–60	Fine sandy loam	SM	A–4		100	100
San Timoteo: SgF2	2–2½	0–24	Loam	CL–ML or CL	A–4		100	95–100
		24	Soft sandstone.					
Saugus: ShF	3–4	0–18	Sandy loam	SM	A–2		100	100
		18–40	Loam	ML or CL–ML	A–4		100	100
		40	Weakly consolidated loamy sediment.					
Soboba:								
SoC	>5	0–12	Gravelly loamy sand	SP–SM or SM	A–1	0–5	55–75	40–55
		12–36	Very gravelly loamy sand.	GP	A–1	0–10	25–45	20–40
		36–60	Very stony sand	SP	A–1	50–70	85–95	75–95
SpC	>5	0–24	Stony loamy sand and very stony loamy sand.	SP–SM	A–1, A–3	30–65	80–95	75–95
		24–60	Very stony sand	SP	A–1	50–70	80–95	75–95
Soper: SrE, SrF	2–3	0–12	Gravelly loam	CL–ML or CL.	A–4		80–95	75–90
		12–26	Gravelly sandy clay loam.	SC or CL	A–6	0–10	80–95	75–90
		26	Sandy conglomerate and soft sandstone.					
Sorrento: StA, StB	>5	0–60	Clay loam	CL	A–6		100	100
Tollhouse: ToF	1–1½	0–12	Sandy loam	SM	A 2	0–5	95–100	90 100
		12	Weathered granitic rock.					
Tujunga:								
TuB	>5	0–60	Loamy sand and coarse sand.	SM or SP–SM	A–1	0–5	100	55–100
TvC	>5	0–36	Gravelly loamy sand	SM or SP SM	A 1, A 2	0 5	70–80	55 75
		36–60	Coarse sand	SP–SM	A–1	0–5	100	55–100
Vista: Vr	2–3¼	0–38	Coarse sandy loam and sandy loam.	SM	A–2		85–100	75–95
		38	Weathered granitic rock.					

[1] NP means nonplastic.
[2] It is assumed that a loam texture will result from mixing stratified layers.

significant in engineering—Continued

Percentage less than 3 in. passing sieve—Cont.		Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 40 (0.42 mm)	No. 200 (0.074 mm)							
		Percent		*Inches per hour*	*Inches per inch of soil*	*pH*	*Mmhos per centimeter at 25°C*	
90–100	70–80	30–40	10–20	0.2–0.6	0.17–0.19	7.9–8.4	0–2	Moderate.
60–75	20–35	NP	NP	2.0–6.0	0.10–0.12	5.6–6.5		Low.
50–70	20–30	NP	NP	2.0–6.0	0.08–0.10	6.1–7.3		Low.
50–70	20–30	NP	NP	2.0–6.0	0.08–0.10	5.6–7.3		Low.
60–80	25–50	15–25	0–5	2.0–6.0	0.10–0.12	5.6–6.5		Low.
85–100	40–60	30–40	10–20	0.2–0.6	0.15–0.17	6.6–7.8		Moderate.
65–75	25–35	NP	NP	2.0–6.0	0.10–0.12	6.6–7.8		Low.
70–85	35–50	20–30	NP–5	2.0–6.0	0.12–0.14	7.4–8.4	0–2	Low.
45–55	20–30	NP	NP	2.0–6.0	0.10–0.12	7.4–8.4	0–2	Low.
70–85	35–50	20–30	NP–5	2.0–6.0	0.12–0.14	7.9–8.4	0–2	Low.
85–95	60–75	20–30	5–10	0.6–2.0	0.15–0.17	7.4–8.4	0–2	Low.
60–70	25–35	NP	NP	2.0–6.0	0.10–0.12	6.1–7.3		Low.
85–95	55–70	20–30	5–10	0.6–2.0	0.15–0.17	6.1–7.3		Moderate.
30–45	5–15	NP	NP	6.0–20	0.06–0.08	6.1–6.5	<1	Low.
15–30	0–5	NP	NP	6.0–20	0.05–0.07	6.1–6.5	<1	Low.
40–50	0–5	NP	NP	20.0+	0.03–0.05	6.6–7.3	<1	Low.
45–55	5–10	NP	NP	6.0–20	0.04–0.06	5.6–6.5	<1	Low.
40–50	0–5	NP	NP	20.0+	0.03–0.05	6.6–7.8	<1	Low.
65–85	50–70	15–30	5–10	0.6–2.0	0.14–0.16	6.1–7.3	0–2	Low.
60–75	35–60	25–35	10–20	0.2–0.6	0.14–0.16	6.1–7.8	0–2	Moderate.
90–100	70–80	30–40	15–25	0.2–0.6	0.17–0.18	6.1–8.4	0–2	Moderate.
60–75	20–35	NP	NP	2.0–6.0	0.10–0.13	5.6–7.3	0–2	Low.
25–50	5–20	NP	NP	6.0–20	0.06–0.07	6.1–7.3		Low.
40–60	10–20	NP	NP	6.0–20	0.05–0.07	6.1–7.3		Low.
25–50	5–10	NP	NP	6.0–20	0.06–0.07	6.1–7.3		Low.
50–75	15–35	NP	NP	2 0–6.0	0.10–0.12	5.6–7.3		Low.

TABLE 5.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The soils instructions for referring to other series

Soil series and map symbols	Degree and kind of limitations for—				Suitability as a source of—	
	Dwellings without basements	Septic tank absorption fields	Shallow excavations	Sanitary landfills (area type)	Cover material for area-type landfills	Topsoil
Alo: AaF	Severe: slopes; high shrink-swell potential.	Severe: slopes; slow permeability.	Severe: slopes; clay texture.	Severe: slopes	Poor: clay texture.	Poor: clay texture.
Chino: Cb	Moderate: moderate shrink-swell potential	Severe: moderately slow permeability.	Slight	Slight: original wetness no longer a limitation.	Fair: silt loam in upper 16 inches, silty clay loam below	Fair: silt loam in upper 16 inches, silty clay loam below.
Chualar: CkA, CkC, CkD.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.	Moderate: clay loam texture.	Slight for CkA and CkC. Moderate for CkD: slopes	Fair: clay loam to a depth of 36 inches.	Fair: clay loam texture.
*Cieneba: CnD, Cp, Cr. For interpretations of Friant soils in Cp, refer to Friant series.	Severe: shallow to bedrock	Severe: steep; shallow to bedrock.	Severe: steep; shallow to bedrock	Severe: steep; shallow to bedrock	Poor: weathered granitic bedrock at a depth of 12 to 20 inches.	Poor: borrow areas difficult to reclaim.
Crafton: Cs2	Severe: slopes	Severe: slopes; moderate depth to bedrock	Severe: slopes; moderate depth to bedrock.	Severe: slopes	Poor: slopes; area reclaim.	Poor: borrow areas difficult to reclaim.
Delhi: Db	Slight	Slight	Severe: sidewall instability.	Severe: rapid permeability	Poor: sandy throughout.	Poor: sandy texture.
Fontana: FoE, FoF	Severe: slopes	Severe. slopes; moderate depth to bedrock.	Severe: slopes; moderate depth to bedrock.	Severe: slopes	Poor: slopes	Fair: clay loam texture; weathered shale at a depth of 22 to 38 inches.
Friant: Fr	Severe: excess slopes; shallow to bedrock.	Severe: slopes; shallow to bedrock.	Severe: slopes; shallow to bedrock.	Severe: slopes; shallow to bedrock	Poor: slopes; limited thickness of material; bedrock at a depth of 10 to 18 inches.	Poor: borrow areas; difficult to reclaim
Garretson: GaC	Moderate: ML material in upper 28 inches	Moderate: moderate permeability.	Slight	Slight	Good	Good
Gaviota: Go	Severe: slopes; shallow to bedrock	Severe: slopes; shallow to bedrock	Severe: slopes; shallow to bedrock.	Severe: slopes; shallow to bedrock.	Severe: slopes; thickness of material; bedrock at a depth of 10 to 16 inches.	Poor: borrow areas; difficult to reclaim.

engineering properties of the soils

ın such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the
that appear in the first column of this table]

Suitability as a source of—			Soil features affecting—			Hydrologic soil group
			Water retention		Irrigation	
Sand	Gravel	Road fill	Embankments, dikes, and levees	Reservoir areas		
Unsuited	Unsuited	Poor: A–7 material; high shrink-swell potential; slopes.	Low strength: high volume change; subject to cracking.	Steep	Steep; slow permeability.	D
Unsuited	Unsuited	Poor: A–4 material in upper 16 inches; A–6 material below.	Very low strength; variable stability; subject to piping.	Moderately slow permeability.	Moderately slow permeability.	B
Unsuited	Unsuited	Poor for A–6 material in upper 36 inches. Fair for A–4 material below.	Low strength; variable stability; subject to piping.	Moderately slow permeability.	Moderately slow permeability; some strongly sloping areas.	B
Unsuited: weathered granite bedrock at a depth of 12 to 20 inches.	Unsuited: weathered granite bedrock at a depth of 12 to 20 inches	Poor: weathered granitic bedrock at a depth of 12 to 20 inches.	Bedrock at a depth of 12 to 20 inches.	Steep; rapid permeability; weathered granitic rock at a depth of 12 to 20 inches.	Shallow to bedrock; slopes.	B
Unsuited: weathered schist rock at a depth of 20 to 36 inches.	Unsuited: weathered schist rock at a depth of 20 to 36 inches.	Poor: outcrops; weathered schist at a depth of 20 to 36 inches.	Moderate strength and stability; subject to piping.	Steep slopes: moderately rapid permeability; weathered schist rock at a depth of 20 to 36 inches.	Moderate depth to bedrock; slopes.	C
Good: SP material below a depth of 18 inches.	Unsuited	Good	Medium strength; low compressibility; rapid compacted permeability.	Rapid permeability	Low water-holding capacity; rapid intake rate.	B
Unsuited	Unsuited	Poor: A–6 material; weathered shale at a depth of 22 to 38 inches; moderate shrink-swell potential; steep.	Low strength; low permeability; low susceptibility to piping.	Moderately slow permeability; slopes; weathered shale at a depth of 22 to 38 inches.	Moderate depth to bedrock; slopes.	C
Unsuited	Unsuited	Poor: steep; hard mica schist at a depth of 10 to 18 inches.	Bedrock at a depth of 10 to 18 inches.	Hard mica schist at a depth of 10 to 18 inches.	Shallow to bedrock; slopes.	D
Unsuited	Unsuited	Fair: mostly A–4 material throughout.	Medium to low strength; medium to low permeability; subject to piping.	Moderate permeability.	Favorable.	B
Unsuited: hard bedrock at a depth of 10 to 16 inches.	Unsuited: hard bedrock at a depth of 10 to 16 inches.	Poor: hard bedrock at a depth of 10 to 16 inches.	Bedrock at a depth of 10 to 16 inches.	Hard sandstone at a depth of 10 to 16 inches; slopes.	Shallow to bedrock; slopes	D

TABLE 5.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitations for—				Suitability as a source of—	
	Dwellings without basements	Septic tank absorption fields	Shallow excavations	Sanitary landfills (area type)	Cover material for area-type landfills	Topsoil
Grangeville: Gr, Gs	Slight: original wetness no longer a problem.	Slight	Slight	Severe: moderately rapid permeability.	Good	Good for Gr. Poor for Gs: saline-alkali.
Greenfield: GtC, GtD	Slight for GtC. Moderate for GtD: slopes	Slight for GtC. Moderate for GtD: slopes.	Slight for GtC. Moderate for GtD: slopes.	Severe: moderately rapid permeability	Good	Good Fair for GtD: slopes.
GuD	Moderate: slopes	Moderate slopes	Moderate: cobbles in upper 12 inches.	Severe: moderately rapid permeability.	Fair: cobbles in upper 12 to 18 inches; slopes.	Poor: cobbles in upper 12 to 18 inches.
Hanford: HaC, HaD, HbA	Slight for HaC and HbA. Moderate for HaD: slopes.	Slight for HaC and HbA. Moderate for HaD slopes.	Slight for HaC and HbA. Moderate for HaD slopes.	Severe: moderately rapid permeability.	Good for HaC and HbA. Fair for HaD: slopes.	Good for HbA. Fair for HaC and HaD: slopes.
Hilmar: Hr	Slight to moderate: SM material in upper 23 inches; ML, CL–ML at a depth of 23 to 60 inches	Severe: slow permeability below a depth of 23 inches.	Severe: poor sidewall stability	Severe: rapid permeability in upper 23 inches	Fair: loamy sand in upper 23 inches Good below: loam.	Poor: sandy in upper 23 inches.
Merrill: Me	Moderate: ML material; nodules at a depth of 25 to 43 inches.	Severe: slow permeability.	Severe: weakly cemented at a depth of 25 to 43 inches.	Slight	Fair: hard nodules at a depth of 25 to 43 inches.	Good in upper 25 inches.
Metz: MgC	Slight	Slight	Severe: gravel; poor sidewall stability.	Severe: moderately rapid permeability.	Poor. coarse sandy loam in upper 19 inches; mostly sand and gravelly sand below.	Fair in upper 19 inches
Monserate: MoC	Moderate. hardpan of silica at a depth of 30 to 45 inches.	Severe: very slow permeability.	Severe: hardpan of silica at a depth of 30 to 45 inches.	Slight	Fair. about 10 inches of sandy loam over 20 inches of clay loam; hardpan of silica below.	Fair in upper 30 inches; sandy loam and clay loam.
Nacimiento: NaE, NaF.	Severe: slopes	Severe: slopes; moderate depth to bedrock.	Severe: slopes; moderate depth to bedrock.	Severe: slopes	Poor slopes; weathered sandstone below.	Poor: clay loam; weathered sandstone at a depth of 26 to 40 inches; slopes up to 50 percent.

engineering properties of the soils—Continued

Suitability as a source of—			Soil features affecting—			Hydrologic soil group
			Water retention			
Sand	Gravel	Road fill	Embankments, dikes, and levees	Reservoir areas	Irrigation	
Poor	Poor	Fair. A–4 material	Medium strength; medium permeability; subject to piping	Moderately rapid permeability.	Moderate to high available water capacity; moderately rapid permeability; saline-alkali.	B to C
Poor: fines	Poor: fines	Good in upper 16 inches. Fair at a depth of 16 to 50 inches. Good for A–4 below.	Medium strength; fair to good compaction characteristics; subject to piping	Moderately rapid permeability; strong slopes in some places.	High available water capacity; moderately rapid permeability.	B
Poor: fines	Poor: fines	Good in upper 16 inches; some cobbles in upper 12 to 18 inches Fair at a depth of 16 to 50 inches Good for A–4 below.	Medium strength; fair to good compaction charcteristics; subject to piping; exclusion of cobbles longer than 6 inches is needed	Moderately rapid permeability; strong slopes	High available water capacity; moderately rapid permeability; cobbles in upper 12 inches.	B
Poor: fines	Poor: fines	Good.	Medium strength; medium to low permeability; subject to piping.	Moderately rapid permeability; strong slopes in some places.	Moderate available water capacity; moderately rapid permeability.	B
Unsuited	Unsuited	Good for A–2 in upper 23 inches. Fair for A–4 at a depth of 23 to 60 inches	Variable strength; moderate to low stability; subject to piping.	Rapidly permeable in surface; slowly permeable in subsoil.	Rapid intake rate; moderate available water capacity.	C to D
Unsuited	Unsuited	Fair for A–4; some hard nodules at a depth of 25 to 43 inches	Medium strength; subject to piping and cracking.	Slow permeability; weakly cemented at a depth of 25 to 43 inches.	Moderate available water capacity; slow permeability; weakly cemented at a depth of 25 to 43 inches.	C
Poor: fines	Poor: fines	Good	Medium strength and stability; subject to piping.	Rapid permeability below a depth of 19 inches	Low available water capacity; moderately rapid permeability.	A
Unsuited	Unsuited	Poor for A–2, A–4; hardpan of silica at a depth of 30 to 45 inches.	Medium strength; low permeability; good compaction.	Very slow permeability	Moderately slow permeability over hardpan at a depth of 30 inches.	C
Unsuited	Unsuited	Poor for A–6 in upper 28 inches; weathered sandstone below a depth of 26 to 40 inches.	Sandstone at a depth of 26 to 40 inches.	Steep; weathered sandstone at a depth of 26 to 40 inches.	Unsuited	C

TABLE 5.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitations for—				Suitability as a source of—	
	Dwellings without basements	Septic tank absorption fields	Shallow excavations	Sanitary landfills (area type)	Cover material for area-type landfills	Topsoil
Oak Glen: OaC, OgD, OgE.	Slight for OaC. Moderate for OgD: slopes. Severe for OgE: slopes	Slight for OaC. Moderate for OgD: slopes. Severe for OgE: slopes.	Moderate for OaC and OgD: gravel; sidewall stability Severe for OgE: slopes.	Severe: moderately rapid permeability.	Good for OaC. Fair for OgD: gravelly sandy loam. Poor for OgE: slopes.	Poor: gravelly throughout profile. Good for OaC in upper 20 inches.
Psamments and Fluvents, frequently flooded: Ps Too variable for interpretation.						
Ramona: RmC, RmD, RmE2.	Slight for RmC: SM material in upper 3 inches. Moderate for RmD: slopes. Severe for RmE2: slopes.	Severe: moderately slow permeability.	Slight for RmC; clay loam at a depth of 32 to 48 inches Moderate for RmD: slopes. Severe for RmE2: slopes.	Slight for RmC. Moderate for RmD: slopes. Severe for RmE2: slopes.	Fair for RmC, RmD: sandy loam in upper 23 inches; clay loam below. Poor for RmE2: slopes.	Good for RmC in upper 32 inches. Fair: for RmD: slopes. Poor for RmE2: slopes.
San Emigdio: SaD, SbC, ScA, ScC,	Slight for SbC, ScA, ScC. Moderate for SaD: slopes.	Slight for SbC, ScA, ScC. Moderate for SaD: slopes.	Slight for SbC, ScA, ScC. Moderate for SaD: slopes.	Severe: moderately rapid permeability.	Good for ScA, ScC Fair: for ScD: slopes. Fair for SbC: gravelly sandy loam in upper 16 inches.	Good for SbC in upper 16 inches; gravelly. Fair for SaD, ScC: slopes.
San Timoteo: SgF2	Severe: slopes	Severe: slopes; moderate depth to bedrock.	Severe: slopes; moderate depth to bedrock.	Severe: slopes	Poor: slopes; sandstone at a depth of 24 to 30 inches.	Poor: borrow areas are difficult to reclaim.
Saugus: ShF	Severe: slopes	Severe: slopes	Severe: slopes	Severe: slopes	Poor: slopes	Poor: slopes
Soboba: SoC, SpC	Slight	Slight	Severe: too gravelly or too stony throughout.	Severe: rapid permeability.	Poor: too gravelly or stony below.	Poor: very stony below a depth of 10 inches.
Soper SrE, SrF	Severe: slopes	Severe: slopes; depth to bedrock.	Severe: slopes, depth to bedrock	Severe: slopes	Poor slopes; sandstone at a depth of 22 to 36 inches	Poor: gravelly loam and sandy clay loam in upper 26 inches; borrow areas difficult to reclaim.
Sorrento: StA, StB	Moderate: moderate shrink-swell potential	Severe. moderately slow permeability.	Moderate. clay loam texture.	Slight	Fair. clay loam texture throughout.	Fair: clay loam

engineering properties of the soils—Continued

Suitability as a source of—			Soil features affecting—			
			Water retention			
Sand	Gravel	Road fill	Embankments, dikes, and levees	Reservoir areas	Irrigation	Hydrologic soil group
Poor fines	Poor. fines	Good for OaC, and OgD. Fair for OgE: slopes	Medium strength; subject to piping; medium permeability.	Moderately rapid permeability; steep in some places.	Moderately rapid permeability; steep in some places.	B
Unsuited	Unsuited	Fair: A–6 material	Medium to low strength; subject to piping; medium to low permeability.	Moderately slow permeability in subsoil; steep in some places	Moderately slow permeability; steep in some places.	B
Poor: fines	Poor: fines.	Good	Medium strength; medium to low permeability; medium to high susceptibility to piping.	Moderately rapid permeability.	Moderate to high available water capacity; moderately rapid permeability.	B
Unsuited	Unsuited	Poor slopes; sandstone at a depth of 24 to 30 inches	Sandstone at a depth of 24 to 30 inches.	Sandstone at a depth of 24 to 30 inches; steep	Slopes; sandstone at a depth of 24 to 30 inches	C
Unsuited	Unsuited	Poor: slopes	Medium to low strength; medium to low permeability to piping; steep slopes	Moderate permeability; weakly consolidated sediment at a depth of 30 to 40 inches; steep.	Slopes	B
Unsuited for SpC: too stony Good for SoC.	Unsuited for SpC: too stony Good for SoC.	Good for SoC. Poor for SpC: too stony	High strength; rapid permeability.	Rapid permeability	Very low available water capacity; rapid permeability.	A
Unsuited	Unsuited	Poor at a depth of 22 to 36 inches; slopes	Sandstone at a depth of 22 to 36 inches.	Sandstone at a depth of 22 to 36 inches; slopes.	Slopes; sandstone at a depth of 22 to 36 inches.	B
Unsuited	Unsuited	Poor for A–6 throughout.	Medium to low strength; medium compressibility; low permeability	Moderately slow permeability	High water-holding capacity; moderately slow permeability	B

TABLE 5.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitations for—				Suitability as a source of—	
	Dwellings without basements	Septic tank absorption fields	Shallow excavations	Sanitary landfills (area type)	Cover material for area-type landfills	Topsoil
Tollhouse. ToF	Severe: slopes; shallow to bedrock	Severe. slopes; shallow to bedrock.	Severe: slopes; shallow to bedrock.	Severe: slopes; shallow to bedrock	Poor. slopes; weathered granitic rock at a depth of 10 to 20 inches.	Poor. borrow areas difficult to reclaim
Tujunga. TuB	Slight	Slight	Severe: poor sidewall stability.	Severe. rapid permeability.	Poor. loamy sand and coarse sand throughout.	Poor. sandy throughout
TvC	Slight	Slight	Severe: poor sidewall stability	Severe: rapid permeability	Poor: gravelly loamy sand in upper 36 inches; coarse sand below.	Poor: gravelly loamy sand.
Vista: Vr	Severe: slopes	Severe: slopes; moderate depth to bedrock.	Severe: slopes; moderate depth to bedrock.	Severe: slopes	Poor: slopes	Poor: borrow areas difficult to reclaim.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 4. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 4.

Depth to bedrock or hardpan is the distance from the surface of the soil to the upper surface of the restrictive layer.

Soil texture is described in table 4 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand."

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic. If the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic; and the liquid limit is the moisture content at which it changes from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 4.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 4 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the

engineering properties of the soils—Continued

Suitability as a source of—			Soil features affecting—			
			Water retention			
Sand	Gravel	Road fill	Embankments, dikes, and levees	Reservoir areas	Irrigation	Hydrologic soil group
Unsuited..	Unsuited	Poor: granitic rock at a depth of 10 to 20 inches; slopes.	Bedrock at a depth to 10 to 20 inches.	Moderately rapid permeability, steep; granitic rock at a depth of 10 to 20 inches.	Bedrock at a depth to 10 to 20 inches; slopes.	D
Poor. fines	Poor fines	Good	Medium strength; low to medium compressibility; medium to high permeability.	Rapid permeability	Low available water capacity; rapid intake.	A
Fair fines	Fair fines	Good	Medium strength; low to medium compressibility; medium to high permeability.	Rapid permeability	Low available water capacity; rapid intake	A
Unsuited	Unsuited	Poor: granitic rock at a depth of 24 to 40 inches; slopes.	Granitic bedrock at a depth of 24 to 40 inches; slopes.	Steep; bedrock at a depth of 24 to 40 inches	Steep; bedrock at a depth of 24 to 40 inches.	C

soil. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 20° C. Salinity affects the suitability of a soil for crop production, its stability when used as construction material, and its corrosiveness to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Engineering interpretations

The soil interpretations in table 5 are based on the soil properties significant to engineering shown in table 4, on test data for soils in nearby or adjoining areas, and on the experience of engineers and soil scientists with the soils of the survey area. In table 5, ratings are used to summarize limitations or suitability of the soils for all listed purposes except irrigation, reservoirs, and embankments. For these particular uses, table 4 lists those soil features to be considered in planning, installation, and maintenance.

Soil limitations are indicated by the terms *slight, moderate,* and *severe. Slight* means that soil properties are generally favorable for the specified use or that limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is shown by the terms *good, fair,* and *poor,* which have meanings approximately parallel to the terms *slight, moderate,* and *severe.*

The following are explanations of some of the columns in table 5.

Dwellings without basements are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 5 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the

system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Shallow excavations are those that require digging or trenching to a depth of less than 5 feet, as for example, excavation for pipelines, sewerlines, phone and power-transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Sanitary landfills (area-type) dispose of refuse. Refuse is placed on the surface of the soil in successive layers. The cover material generally must be brought in. A final cover of soil material at least 2 feet thick is placed over the fill when it is completed. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. The soil material under the proposed site should be investigated so as to determine the probability that leachates from the landfill can penetrate the soil and thereby pollute water supplies.

Criteria used to determine limitation ratings for sanitary landfills are soil drainage class and depth to seasonal water tables, soil permeability, soil slope, and soil texture. The final cover should be soil material that is favorable for the growth of plants. The A horizon, or surface layer, has the best workability and highest content of important organic matter.

Cover material for the area-type landfills generally must be obtained from a source away from the site. Soils, therefore, from another area may need to be given suitability ratings for use as cover. Required soil characteristics for both daily and final cover material are similar.

Suitability of a soil for use as cover is based upon properties that reflect workability, ease of digging, moving, and spreading over the refuse daily during both wet and dry periods. Slope, wetness, and thickness of the soil material are considered. Areas from which soil material is borrowed should be reclaimable. Some damage to the borrow area is expected, but revegetation and erosion control should not become serious problems.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material when preparing a seedbed; natural fertility of the material or the response of plants when fertilizer is applied, and lack of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered is damage that will result to the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 5 provide guidance about where to look for probable sources. A soil rated as a good or fair source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 5 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and they do not indicate the quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and they reflect the relative ease of excavating the material at borrow areas.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in hardpans or other layers that restrict movement of water; amount of water held available for plants; need for drainage; and depth to water table or bedrock.

Hydrologic soil groups are used in watershed planning to estimate runoff from rainfall. Soil properties are considered that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting. These properties are depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The influence of ground cover is treated independently and is not considered in the assignment of hydrologic soil groups.

The soils have been classified into four groups, A through D. Soils in group A have the lowest runoff potential and highest infiltration rates, and soils in group D have the highest runoff rates and slowest infiltration rates. Soils in groups B and C are intermediate in these characteristics.

Use of the Soils for Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 6 the soils of San Bernardino County, Southwestern Part, are rated according to limitations that affect their suitability for golf fairways and lawns, picnic areas, and playgrounds. In this table the degrees of limitations for the specified areas are slight, mod-

TABLE 6. — *Interpretations of the soils for recreational uses*

Soil	Recreational uses		
	Golf fairways and lawns	Picnic areas	Playgrounds
Alo clay, 30 to 50 percent slopes	Severe clay; slopes of more than 15 percent.	Severe slopes of more than 15 percent; clay	Severe: slopes of more than 5 percent; clay.
Chino silt loam.	Slight drainage altered	Moderate: dusty	Moderate· dusty.
Chualar clay loam, 0 to 2 percent slopes.	Moderate clay loam	Moderate: clay loam	Moderate: clay loam
Chualar clay loam, 2 to 9 percent slopes	Moderate. clay loam; slopes of more than 2 percent	Moderate: clay loam	Moderate to severe. slopes of more than 2 percent in places; clay loam.
Chualar clay loam, 9 to 15 percent slopes	Moderate· clay loam; slopes of more than 2 percent	Moderate: clay loam	Severe· slopes of more than 5 percent
Cieneba sandy loam, 9 to 15 percent slopes	Severe. shallow to weathered rock.	Moderate slopes of more than 9 percent	Severe: slopes of more than 5 percent
Cieneba-Friant sandy loams· Cieneba part	Severe slopes of more than 15 percent; shallow to weathered rock	Severe: slopes of more than 15 percent.	Severe· slopes of more than 5 percent
Friant part	Severe: slopes of more than 15 percent; shallow to hard rock	Severe: slopes of more than 15 percent.	Severe. slopes of more than 5 percent.
Cieneba-Rock outcrop complex	Severe slopes of more than 15 percent; shallow to weathered rock	Severe: slopes of more than 15 percent; rocky	Severe: slopes of more than 5 percent; rocky.
Crafton-Rock outcrop complex, eroded	Severe: slopes of more than 15 percent; rocky.	Severe· slopes of more than 15 percent; rocky.	Severe: slopes of more than 5 percent; rocky.
Delhi fine sand.	Severe fine sand	Moderate: fine sand	Severe: fine sand
Fontana clay loam, 15 to 30 percent slopes.	Severe slopes of more than 15 percent	Severe: slopes of more than 15 percent.	Severe. slopes of more than 5 percent.
Fontana clay loam, 30 to 50 percent slopes	Severe: slopes of more than 15 percent	Severe: slopes of more than 15 percent.	Severe· slopes of more than 5 percent.
Friant-Rock outcrop complex	Severe. slopes of more than 15 percent; shallow to hard rock.	Severe· slopes of more than 15 percent; rocky	Severe. slopes of more than 5 percent; rocky.
Garretson very fine sandy loam, 2 to 9 percent slopes.	Moderate: slopes of more than 2 percent.	Slight	Moderate to severe slopes of more than 2 percent in some places.
Gaviota-Rock outcrop complex	Severe slopes of more than 15 percent; shallow to hard rock.	Severe· slopes of more than 15 percent; rocky	Severe: slopes of more than 5 percent; rocky
Grangeville fine sandy loam.	Slight: drainage altered	Slight: drainage altered	Slight drainage altered
Grangeville fine sandy loam, saline-alkali.	Severe excess saline-alkali	Slight drainage altered	Slight: drainage altered
Greenfield sandy loam, 2 to 9 percent slopes	Moderate. slopes of more than 2 percent	Slight	Moderate to severe slopes of more than 2 percent in some places
Greenfield sandy loam, 9 to 15 percent slopes.	Moderate slopes of more than 2 percent.	Moderate. slopes of more than 9 percent	Severe slopes of more than 5 percent.
Greenfield cobbly sandy loam, 5 to 15 percent slopes.	Moderate: slopes of more than 2 percent; surface cobbles	Moderate: some slopes more than 9 percent; cobbles.	Severe: slopes of more than 5 percent.
Hanford coarse sandy loam, 2 to 9 percent slopes	Moderate. slopes of more than 2 percent	Slight	Moderate to severe: slopes of more than 2 percent in some places.

TABLE 6.—*Interpretations of the soils for recreational uses*—Continued

Soil	Recreational uses		
	Golf fairways and lawns	Picnic areas	Playgrounds
Hanford coarse sandy loam, 9 to 15 percent slopes	Moderate: slopes of more than 2 percent	Moderate: slopes of more than 9 percent.	Severe. slopes of more than 5 percent
Hanford sandy loam, 0 to 2 percent slopes.	Slight	Slight	Slight
Hilmar loamy fine sand	Moderate loamy fine sand	Moderate: loamy fine sand	Moderate· loamy fine sand
Merrill silt loam	Moderate: moderately deep to hardpan	Moderate· dusty	Moderate· dusty
Metz coarse sandy loam, 2 to 9 percent slopes	Moderate· slopes of more than 2 percent	Slight	Moderate to severe: slopes of more than 2 percent in some places.
Monserate sandy loam, 2 to 9 percent slopes	Moderate. slopes of more than 2 percent	Slight	Moderate slopes of more than 2 percent in some places.
Nacimiento clay loam, 9 to 30 percent slopes	Moderate to severe: some slopes more than 15 percent.	Moderate to severe some slopes more than 15 percent; clay loam	Severe. slopes of more than 5 percent
Nacimiento clay loam, 30 to 50 percent slopes	Severe. slopes of more than 15 percent.	Severe: slopes of more than 15 percent.	Severe: slopes of more than 5 percent.
Oak Glen sandy loam, 2 to 9 percent slopes	Moderate: slopes of more than 2 percent	Slight	Slight to moderate: slopes of more than 2 percent in some places.
Oak Glen gravelly sandy loam, 9 to 15 percent slopes.	Moderate: slopes of more than 2 percent; gravelly sandy loam.	Moderate: slopes of more than 9 percent	Severe· slopes of more than 5 percent.
Oak Glen gravelly sandy loam, 15 to 30 percent slopes	Severe. slopes of more than 15 percent	Severe: slopes of more than 15 percent	Severe: slopes of more than 5 percent.
Psamments and Fluvents, frequently flooded	Severe: flooded	Severe: flooded	Severe. flooded
Ramona sandy loam, 2 to 9 percent slopes.	Moderate: slopes of more than 2 percent	Slight	Slight to moderate. slopes of more than 2 percent in some places
Ramona sandy loam, 9 to 15 percent slopes.	Moderate: slopes of more than 2 percent	Moderate: slopes of more than 9 percent	Severe slopes of more than 5 percent
Ramona sandy loam, 15 to 30 percent slopes, eroded	Severe: slopes of more than 15 percent	Severe. slopes of more than 15 percent	Severe· slopes of more than 5 percent
San Emigdio sandy loam, 9 to 15 percent slopes.	Moderate· slopes of more than 2 percent	Moderate· slopes of more than 9 percent	Severe· slopes of more than 5 percent.
San Emigdio gravelly sandy loam, 2 to 9 percent slopes	Moderate slopes of more than 2 percent; gravelly sandy loam.	Slight	Slight to moderate: slopes of more than 2 percent in some places
San Emigdio fine sandy loam, 0 to 2 percent slopes	Slight	Slight	Slight
San Emigdio fine sandy loam, 2 to 9 percent slopes	Moderate slopes of more than 2 percent	Slight	Slight to moderate: slopes of more than 2 percent in some places
San Timoteo loam, 30 to 50 percent slopes, eroded	Severe· slopes of more than 15 percent	Severe: slopes of more than 15 percent.	Severe· slopes of more than 5 percent
Saugus sandy loam, 30 to 50 percent slopes	Severe· slopes of more than 15 percent	Severe· slopes of more than 15 percent	Severe: slopes of more than 5 percent

TABLE 6.—*Interpretations of the soils for recreational uses*—Continued

Soil	Recreational uses		
	Golf fairways and lawns	Picnic areas	Playgrounds
Soboba gravelly loamy sand, 0 to 9 percent slopes.	Severe: gravelly loamy sand	Moderate: gravelly loamy sand	Moderate: gravelly loamy sand
Soboba stony loamy sand, 2 to 9 percent slopes.	Severe: stony loamy sand	Moderate: stony loamy sand	Moderate: stony loamy sand
Soper gravelly loam, 15 to 30 percent slopes	Severe: slopes of more than 15 percent.	Severe: slopes of more than 15 percent.	Severe: slopes of more than 5 percent
Soper gravelly loam, 30 to 50 percent slopes	Severe: slopes of more than 15 percent.	Severe: slopes of more than 15 percent.	Severe: slopes of more than 5 percent.
Sorrento clay loam, 0 to 2 percent slopes.	Moderate: clay loam	Moderate: clay loam	Moderate: clay loam.
Sorrento clay loam, 2 to 5 percent slopes.	Moderate: slopes of more than 2 percent; clay loam	Moderate: clay loam	Moderate: clay loam; slopes of more than 2 percent
Tollhouse sandy loam, 30 to 50 percent slopes.	Severe: slopes of more than 15 percent.	Severe: slopes of more than 15 percent.	Severe: slopes of more than 5 percent.
Tujunga loamy sand, 0 to 5 percent slopes.	Moderate: loamy sand	Moderate: loamy sand	Moderate: loamy sand; slopes of more than 2 percent in some places.
Tujunga gravelly loamy sand, 0 to 9 percent slopes.	Severe: gravelly loamy sand	Moderate: gravelly loamy sand	Moderate: gravelly loamy sand; slopes of more than 2 percent in some places.
Vista-Rock outcrop complex.	Severe: slopes of more than 15 percent; rocky.	Severe: slopes of more than 15 percent; rocky.	Severe: slopes of more than 5 percent; rocky.

erate, or severe. For each degree of limitation it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. *Moderate* means that the limitations can be overcome or modified by planning, by design, or by special maintenance. *Severe* means that costly soil reclamation, special design, intense maintenance, or a combination of these is required.

Golf fairways and lawns refer to tracts around residences, factories, apartment houses, school buildings, and in intensively used parks. The surface in such areas needs to be free of rock outcrops and coarse fragments. The limitations for lawns and golf fairways are based on soil properties, but they do not take into account such factors as location, which are important in selecting a site. They do not apply to golf greens and sandtraps, because most of these are manmade. Also, the need for leveling, the need for topsoil, and the kind of grass in the area were not considered.

Explanations of the degree of limitation for golf fairways and lawns are given in the following paragraphs.

A soil has *slight* limitations for lawns and golf fairways if all of the following features apply: slopes are less than 2 percent; the surface layer is sandy loam, fine sandy loam, very fine sandy loam, loam, and silt loam; there are no cobblestones or other stones; depth to hard bedrock, a hardpan, or a seasonal water table is more than 40 inches; drainage is moderately good to good; permeability of the subsoil is moderate or moderately rapid; available water holding capacity is more than 5 inches; electrical conductivity at 25° C, in millimhos per centimeter, is less than 4; and percentage of exchangeable sodium is less than 15 for the upper 20 inches of the soil.

A soil that has *moderate* limitations for this use has one or more of the following features: slopes are 3 to 15 percent; the surface layer is loamy sand, sandy clay loam, silty clay loam, or clay loam or is gravelly; cobblestones or other stones occupy less than 3 percent of the surface area; depth to hard bedrock, a hardpan, or the seasonal water table is between 20 and 40 inches; drainage is somewhat excessive or somewhat poor; permeability of the subsoil is rapid or moderately slow; available water holding capacity is 3.75 to 5.0 inches; electrical conductivity at 25° C, in millimhos per centimeter, is between 4 and 8; and percentage of exchangeable sodium is less than 15 for the upper 20 inches of the soil.

A soil that has *severe* limitations for lawns and golf fairways has one or more of the following features: slopes are more than 15 percent; the surface layer is sand, gravelly sand, gravelly loamy sand, and gravelly clay or the soil is very gravelly; cobblestones or other

stones cover more than 3 percent of the surface area; depth to hard bedrock, a hardpan, or the seasonal water table is less than 20 inches; drainage is excessive, poor, or very poor; permeability of the subsoil is very rapid, slow, or very slow; available water holding capacity is less than 3.75 inches; electrical conductivity at 25° C, in millimhos per centimeter, is more than 8; percentage of exchangeable sodium is more than 15 for the upper 20 inches of the soil.

Picnic areas are attractive natural or landscaped tracts used mainly for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry. They are free of flooding during the season of use; and they do not have slopes or stoniness that greatly increase cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

How the Soils Were Formed and Classified

In this section the factors that affect the formation of the soils in the survey area are discussed and important processes in the morphology of the soil are described. The classification of the soils by higher categories is given.

Factors of Soil Formation

Soil is a natural body on the surface of the earth in which plants grow. It is composed of organic and mineral matter. Soils differ in their appearance, composition, productivity, and management requirements in different localities or even within short distances in the same locality. The factors that cause soils to differ are the physical and chemical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the biological influences; the relief, or lay of the land; and the length of time the factors of soil formation have acted on the soil material. The relative influence of each factor differs from place to place, but generally the interaction of all factors determines the kind of soil that forms in any given place.

Generally the changes in soils take place gradually over a fairly long period. In some soils newly added material tends to make up for losses of material, and in many areas there is a balance between the two. Over a long period, therefore, net changes under natural conditions may be only minor.

The influences of each soil-forming factor on the soils of the San Bernardino County, Southwestern Part, are summarized in the paragraphs that follow.

Parent material

Parent material is the weathered rocks or unconsolidated mass from which soils form. It is largely responsible for the chemical and mineralogical composition of soils. In the survey area more soils formed in alluvium than in residuum from weathered rocks. The residual soils formed in material weathered from sedimentary, granitic, and metamorphic rocks. These strongly sloping to steep soils are shallow to very shallow, and bedrock crops out in many places. Examples are soils of the Cieneba, Crafton, Friant, Gaviota, and Vista series. Cieneba, Vista, and Tollhouse soils formed in residuum from tonalite and granodiorite. They are sandy loam throughout the profile, and they contain many angular particles of quartz. The parent material of Gaviota soils is hard sandstone.

The moderately deep to deep but weakly developed Alo, Fontana, Nacimiento, San Timoteo, and Saugus soils formed in strongly sloping to steep areas. Alo soils formed in fine-textured sedimentary deposits of interbedded fine-grained sandstone and shale. They are deep-cracking soils of high clay content. Fontana and Nacimiento soils formed in calcareous sedimentary formations. San Timoteo soils formed in soft, calcareous sandstone while Saugus soils formed in slightly acid to neutral, weakly consolidated, loamy sedimentary material. Some readers may be interested in learning more about the geology of the area and in studying the relationship of parent material and land forms to soil formation. Further details about the geology of the survey can be obtained from material published by the California Division of Mines (*6*).

The soils that formed in unconsolidated alluvium derived from granitic rocks are those of the Chino, Chualar, Delhi, Grangeville, Greenfield, Hanford, Hilmar, Merrill, Monserate, Oak Glen, Ramona, Soboba, and Tujunga series. Merrill soils are on nearly level fans; Monserate soils are on older gently sloping to moderately sloping terraces and fans; and the rest are on recent alluvial fans or on valley bottoms. The Chualar and Ramona soils have a moderately developed profile; Monserate soils have an indurated silica-cemented hardpan; and Merrill soils have underlying layers that are weakly cemented with silica and lime.

Young soils that formed in alluvium derived from sedimentary rocks are those of the Garretson, Metz, San Emigdio, and Sorrento series.

Climate

Climate has a strong influence on soil formation. Heat and moisture greatly influence the kind of vegetation that grows and the rate at which organic matter decomposes and constituent rock materials weather. They also influence erosion of the soil and accumulation of the weathering products in them. The survey area has a Mediterranean climate. Summers are hot and dry and winters are cool and wet.

Rainfall is about 12 to 16 inches per year on the valley floors, low fans, and foothills. It rains less in those areas than it does at a higher elevation. The climate is hotter and drier, and the vegetation, mainly annual grasses and forbs, is less abundant. Roots are fine, and the root zone is shallow. This kind and density of vegetation does not return much residue to the soil, and the warm, moist weather in fall and spring hastens decomposition.

In areas at lower elevation there is sufficient rainfall that carbonates have moved downward to the lower part of the profile. All the carbonates have leached from excessively drained to somewhat excessively drained soils, such as those of the Delhi, Tujunga, and Soboba series. Hanford, Greenfield, and Ramona soils are in a climatic zone that is typically transitional between desert and forest. These soils formed in similar parent material under chaparral (southern California brush) or grasses and oaks. Enough rain falls that clay-forming minerals weather, move downward, and accumulate more rapidly in soils under forest than soils in desert. The soils under forest have a darker colored A1 horizon, but generally have a hard and massive surface layer and low organic-matter content. They are highly susceptible to erosion. The morphology and genesis of these and similar soils, which occupy large areas throughout southern California, have been studied (*8*).

At an elevation above 3,500 feet, rainfall increases to about 25 inches, and the climate is cool and moist. Soils that formed in these areas are more favorable for plant growth and, consequently, for the accumulation of organic matter. The plant community includes more perennial grasses, shrubs, and trees. Cooler temperatures, a shorter growing season, and vegetation that has coarser and deeper roots result in an increased accumulation of organic matter. Tollhouse, Oak Glen, and Crafton soils in this part of the area have a thick, dark-colored, friable surface layer and appreciable amounts of organic matter.

Biological forces

Vegetation is the dominant biological force affecting the formation of soils in the southwestern part of San Bernardino County. Animals, insects, bacteria, and other organisms also add organic matter to the soils, but their contribution to the accumulation of organic matter and cycling nutrients to the surface soil is dependent on the kind and density of the vegetation.

Originally most of the county was in open areas of grass, dominantly bunchgrass. As cultivation increased, annual grasses and forbs replaced the bunchgrass. Among the soils that formed in open areas of grass are Delhi, San Emigdio, Hanford, Greenfield, Ramona, Soboba, and Tujunga soils. Some of these soils have a dark-colored A1 horizon, but inherent organic-matter content is rather low. On soils that have a higher water table, such as Chino, Grangeville, and Merrill soils, the grasses were in thick stands that consisted of rhizotomous grasses, sedges, rushes, and meadow grasses. Organic matter accumulated and formed a thick A1 horizon in these soils.

At a higher elevation, the dominant vegetation is grasses, oaks, and some pine. Vegetation grows better in the areas of higher rainfall, and among the soils that have a dark-colored surface horizon as a result of the increased amount of plant residue returned to the soil are Oak Glen, Tollhouse, and Crafton soils.

The hot summer temperatures have a profound effect upon the accumulation of organic matter. These not only increase the oxidation rate of organic matter, but they also create a poor habitat for animals, insects, bacteria, and other organisms. The annual grasses and forbs provide limited shade and thus offer limited protection from these high temperatures. As a result many of the soils are low in content of organic matter; conversely, the soils at high elevations are cooler and support perennial grasses, shrubs, and some trees. All of these plants provide more shade, thus reducing the soil temperature and the rate of oxidation of organic matter. They also provide a better habitat for animals, insects, bacteria, and other organisms.

Soil formation is also influenced by small animals, insects, earthworms, and micro-organisms (*15*). They add organic matter, aerate the soil material, and mix soil horizons. Small animals, such as rodents, have brought lime to the surface of the Fontana and Nacimiento soils. Krotovinas (filled tunnels) made by burrowing animals are rather common in the Hanford, Greenfield, and San Emigdio soils. Ground squirrels have considerably influenced the genesis of Vista soils (*10*).

Relief

Relief influences soil formation by its effect on drainage and erosion. Erosion gradually wears away the mountains and soils and fills the valleys with erosion products. In level low-lying areas, water tends to collect and stand on the surface before it slowly drains away, enters the soil, or evaporates. This results in an environment of chemical reduction and is characterized by mottles, high organic-matter content, dark surface colors, gleyed soil colors, and accumulations of salts and lime carbonates. Chino, Grangeville, and Merrill soils formed under such impeded drainage conditions in poorly aerated areas. The Santa Ana River and its tributaries provide good drainage in much of the middle and eastern parts of the survey area. On convex, more sloping alluvial fans and basins, the soils are better drained than those of the low-lying areas south of the community of Chino near Prado Flood Control Basin. Soils in the Soboba, Tujunga, Delhi, Hanford, Greenfield, and Ramona series are examples of well-drained soils in this area.

In the upland hills slopes range from strongly sloping to steep, runoff is medium to rapid, and the hazard of erosion is severe. Few distinct horizons are present, because the parent material erodes away before they can form. Cieneba, Crafton, Gaviota, and Saugus soils are suitable examples.

Vista soils tend to occupy rounded hilltops and upper and middle back slopes. Little runoff occurs in these areas because most of the rainwater percolates through the soil. As a result the soil is dry for much of the

year, weathering is minimal for the area, and only a small amount of clay accumulates in the profile.

Time

Time is an important factor in soil formation. More time is required to develop a soil with strong profile development than a soil with little or no profile development. The apparent age of any soil is a function of the effects and interaction of the other soil-forming factors. A soil with little or no development is said to be young, and a soil with strongly expressed horizons is considered old. The apparent age of the soils in Southwestern San Bernardino County ranges from young to old. The amount of time the soil parent material has been in place and the effects of other soil-forming factors, not its geologic age, are directly related to soil age, or profile development.

The Cieneba and Vista soils formed in residuum weathered from tonalite and granodiorite of the Mesozoic Age. These rocks are among the oldest in the area; but these two soils are strongly sloping to steep and erode easily so that there is only slight evidence of profile development. On the recent alluvial fan deposits, the soils have little profile development. Examples of these soils are Chino, Delhi, Grangeville, Hanford, Hilmar, Oak Glen, Soboba, and Tujunga, as well as Garretson, Metz, Sorrento, and San Emigdio soils. The Greenfield, Ramona, and Chualar soils occupy the older Pleistocene terraces and fans. These soils have a well-developed profile and horizons of clay accumulation, or a B2t horizon. The soils of more recent formations lack horizons of clay accumulation. Another example is the Monserate soils. These soils not only have horizons where clay has accumulated but also have silica-cemented duripans. They are in older, more stable parts of the landscape. The duripan of the Monserate soils is similar to that of the San Joaquin soils in the Sacramento area. The age of the San Joaquin soils has been determined, using new age-dating techniques, to be about 100,000 years (*7*). A similar age may be inferred for the Monserate series.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics (*9*). Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their reponse to manipulation (*12*). First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*18*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*3, 11, 16*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 7, the soil series of San Bernardino County, Southwestern Part, are placed in some categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols.

The five soil orders represented in San Bernardino County, Southwestern Part, are Entisols, Inceptisols, Mollisols, Alfisols, and Vertisols. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Entisol).

SUBORDER. Each order is divided into suborders that are based mainly on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (Aqu, meaning water or wet, and *ent* from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds or sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquents (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *ent*, from Entisols).

SUBGROUP. Great groups are divided into subgroups, one representing the central (typic) segment

TABLE 7. — *Soil series classified according to the current system of classification*
[Classification as of July 1972]

Series	Family	Subgroup	Order
Alo	Fine, montmorillonitic, thermic	Typic Chromoxererts	Vertisols.
Chino[1]	Fine-loamy, mixed, thermic	Aquic Haploxerolls	Mollisols
Chualar	Fine-loamy, mixed, thermic	Typic Argixerolls	Mollisols
Cieneba	Loamy, mixed, nonacid, thermic, shallow	Typic Xerorthents	Entisols
Crafton	Coarse-loamy, mixed, mesic	Entic Haploxerolls	Mollisols
Delhi	Mixed, thermic	Typic Xeropsamments	Entisols.
Fontana	Fine loamy, mixed, thermic	Calcic Haploxerolls	Mollisols
Friant	Loamy, mixed, thermic	Lithic Haploxerolls	Mollisols
Garretson	Fine-loamy, mixed, nonacid, thermic	Typic Xerothents	Entisols
Gaviota	Loamy, mixed, nonacid, thermic	Lithic Xerorthents	Entisols
Grangeville	Coarse-loamy, mixed, thermic	Fluvaquentic Haploxerolls	Mollisols
Greenfield	Coarse-loamy, mixed, thermic	Typic Haploxeralfs	Alfisols.
Hanford	Coarse-loamy, mixed, nonacid, thermic	Typic Xerorthents	Entisols
Hilmar	Sandy over loamy, mixed (calcareous), thermic	Aeric Halaquepts	Inceptisols
Merrill	Fine-silty, mixed, thermic	Aquic Calcixerolls	Mollisols
Metz	Sandy, mixed, thermic	Typic Xerofluvents	Entisols.
Monserate	Fine-loamy, mixed, thermic	Typic Durixeralfs	Alfisols.
Nacimiento	Fine-loamy, mixed, thermic	Calcic Haploxerolls	Mollisols
Oak Glen	Coarse-loamy, mixed, mesic	Pachic Haploxerolls	Mollisols
Ramona	Fine-loamy, mixed, thermic	Typic Haploxeralfs	Alfisols
San Emigdio	Coarse-loamy, mixed (calcareous), thermic	Typic Xerofluvents	Entisols
San Timoteo	Coarse-loamy, mixed (calcareous), thermic	Typic Xerorthents	Entisols.
Saugus	Coarse-loamy, mixed, nonacid, thermic	Typic Xerorthents	Entisols
Soboba	Sandy-skeletal, mixed, thermic	Typic Xerorthents	Entisols
Soper	Fine-loamy, mixed, thermic	Typic Argixerolls	Mollisols.
Sorrento[1]	Fine-loamy, mixed, thermic	Calcic Haploxerolls	Mollisols.
Tollhouse	Loamy, mixed, mesic, shallow	Entic Haploxerolls	Mollisols
Tujunga	Mixed, thermic	Typic Xeropsamments	Entisols
Vista	Coarse-loamy, mixed, thermic	Typic Xerocherpts	Inceptisols

[1] In San Bernardino County, Southwestern Part, the following soils are taxadjuncts to the series for which they are named:

Chino soils tend to have bright, distinct mottles higher in the profile than is within the defined range for the Chino series.

Sorrento soils lack segregated lime at a depth of less than 40 inches, which is not within the defined range for the Sorrento series. These differences do not alter the usefulness or behavior of these soils.

of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquents (a typical Haplaquent).

FAMILY. Soil families are separated within subgroup mainly on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizon, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names of texture, mineralogy, and so on, that are used to differentiate families (see table 7). An example is the coarse-loamy, siliceous, acid, thermic family of Typic Haplaquents.

The five soil orders recognized in San Bernardino County, Southwestern Part, and the great groups and subgroups that are represented in the survey area are described in the following paragraphs.

Alfisols are soils that have been in place for a sufficient length of time for silica clay to move downward and accumulate. They are characterized by massive and hard surface horizons and argillic horizons that have moderate to high base saturation. Two great groups of Alfisols that have one subgroup each are recognized in the survey area.

The Haploxeralfs are well-drained soils that are dry to a depth of at least 20 inches because of the climate. They consist of only one subgroup in this survey area. The Typic Haploxeralfs are well-drained soils that are low in organic-matter content. Greenfield and Ramona soils are placed in this subgroup. The Typic Durixeralfs are well-drained soils that are low in organic-matter content. Greenfield and Ramona soils are placed in this subgroup. The Typic Durixeralfs, the only subgroup in the Durixeralfs in the area, are moderately well drained soils that have a duripan with an upper boundary within 40 inches of the surface but below an argillic horizon. Monserate soils are in this subgroup of Typic Durixeralfs.

Entisols are recent soils that show little or no evidence of horizon development except that some soils may have weak surface horizons. Three great groups of Entisols having one to two subgroups are recognized in the survey area and shown in table 7.

The Xerorthents are well-drained to excessively

drained soils that have a xeric moisture regime. Most of these soils are on sloping recent erosional land surfaces and lose water by runoff. These soils have been leached sufficiently to remove nearly all of the salts from the upper parts of the profile. The Typic Xerorthents are not saturated with water at a depth of less than 60 inches at any time of the year. They are very deep to shallow to soft or hard bedrock. Soils of the Cieneba, Garretson, Hanford, San Timoteo, Saugus, and Soboba series are placed in the subgroup of Typic Xerorthents. Lithic Xerorthents are like Typic Xerorthents except they are shallow to hard rock. Gaviota soils are 10 to 16 inches deep over hard sandstone and are placed in the subgroup of Lithic Xerorthents.

The Xerofluvents formed in recent water-deposited sediment in such areas as flood plains, fans, and the deltas of rivers and small streams. Flooding is frequent unless these areas are protected by dikes or levees. Stratification of the soil material is normal. Layers of a given texture tend to alternate with layers of other textures. Strata of clayey or loamy material commonly have more organic carbon than more sandy overlying materials. Most alluvial sediment coming from eroding soils or streambanks contains appreciable amounts of organic carbon that is mainly associated with the clay fraction. In these sediments, organic-matter content decreases irregularly with increasing depth or remains more than 0.2 percent carbon to a depth of 50 inches. If the texture remains similar as depth increases, content of organic carbon decreases regularly with increasing depth. The proportion of carbon at increasing depth is higher than that in soils that formed in other parent materials because alluvial deposits are generally recent and loamy. Thin strata of sand have less organic carbon if the finer sediment at a depth of 50 inches or below is 0.2 percent carbon or more. Slopes are less than 25 percent, but other features such as texture and content of coarse fragments between depths of 10 and 40 inches of the series control section, lack of wetness, depth to hard or soft rock and to fragments of diagnostic horizons are the same for the Xerofluvents as they are for the Xerorthents. The Typic Xerofluvents, the only subgroup of the Xerofluvents in this survey area, are somewhat excessively drained to well-drained soils that, in many places, have thin strata of contrasting textures below the surface layer. Metz and San Emigdio soils are in this subgroup.

The Xeropsamments are well sorted, freely drained soils that formed under a Mediterranean climate and that have weatherable minerals in the sand fraction. These soils are moist in winter and very dry in summer. They formed on terraces or outwash plains or are in dunes under a mixture of grasses, shrubs, or trees. They have low available water capacity, blow or shift in many places, and support wheeled vehicles poorly. The texture in all subhorizons between depths of 10 and 40 inches are limited to sand, fine sand, loamy sand, or coarse sand. All the horizons are less than 35 percent, by volume, gravel or coarser fragments. No identifiable fragments of diagnostic horizons generally occur without distinguishable order below the surface horizon and within a depth of 40 inches (series control section). Xeropsamments are not permanently saturated with water and lack characteristics associated with wetness such as gley colors and mottles. Typic Xeropsamments, the only subgroup in the Xeropsamments great group in this survey area, are excessively drained to somewhat excessively drained soils. The Delhi and Tujunga series are in this subgroup. Delhi and Tujunga soils are sandy throughout, and Delhi soils have been reworked by the action of wind.

Inceptisols are soils in moister regions that show slight evidence of change. They have altered horizons that have lost bases, or iron and aluminum, but retain some weatherable minerals, or they have horizons of slight accumulations of translocated lime, silica, iron, or bases. Two great groups that have one subgroup each are recognized in the survey area. Aeric Halaquepts is the only subgroup of the Halaquepts. This subgroup includes moderately well drained soils that are light colored, generally grayish, and either have ground water that stands at or near the surface or have been artificially drained. They are, in the original conditions, wet soils that occur in rather warm regions with significant differences between summer and winter soil temperatures. The Hilmar series is in this subgroup of Aeric Halaquepts.

Xerochrepts are well-drained, brownish soils that formed under a Mediterranean climate. Many are steep and are underlain by rock. They formed under treegrass vegetation. Typic Xerochrepts is the only subgroup of the Xerochrepts in the survey area. Vista soils are placed in this subgroup because they have cambic horizons and occur in climatic regimes that are moist and cool in summer and dry thoroughly in summer.

Mollisols are soils that have a relatively thick, dark-colored, humus-rich surface layer that is high in bases and has moderate to strong structure. They occur under grass or under a savannah-type vegetation of open woodland and grass. These are transitional soils that lie between the soils of drier climate and the soils of the more humid climate of wooded areas.

Three groups of Mollisols that have one to six subgroups are recognized in the survey area.

The Typic Argixerolls is the only subgroup of Argixerolls in the survey area. The main distinguishing characteristic of these soils is that they have B2t (argillic) horizons in which a significant amount of clay has accumulated. Other characteristics of this subgroup are that the soils lack lime or silica-cemented hardpans within the upper parts of the profile. The well-drained Chualar and Soper soils are in this subgroup.

The Aquic Calcixerolls, the only subgroup of the Calcixerolls in the survey area are somewhat poorly drained. Soils in this subgroup exhibit properties of poor drainage, such as mottles and gley colors and accumulation of calcium in the upper part of the profile. The somewhat poorly drained Merrill soils are in this subgroup.

The Haploxerolls are somewhat poorly drained to

excessively drained soils that have slightly altered parent material or horizons in which lime carbonates have accumulated beneath the dark-colored surface. They consist of five subgroups.

The Entic Haploxerolls are well drained to excessively drained soils, such as those of the Crafton and Tollhouse series. These soils lack horizons or have only weakly developed horizons beneath the dark-colored surface.

Calcic Haploxerolls are made up of well-drained soils that are shallow to lime accumulation (calcic horizons). Fontana, Nacimiento, and Sorrento soils are in this subgroup.

Fluvaquentic Haploxerolls are soils that have low-chroma mottles and are either shallow to ground water or have been artificially drained. Content of organic carbon decreases irregularly with increasing depth. The soils are shallower than normal to secondary carbonates, if any, because the ground water fluctuates. The somewhat poorly drained Grangeville soils are in this subgroup.

Pachic Haploxerolls are made up of well-drained soils. Oak Glen are the only soils in this subgroup in the survey area. They have a thicker dark-colored surface horizon than is typical of the Haploxerolls.

Lithic Haploxerolls are shallow to bedrock. The somewhat excessively drained Friant soils, which are 10 to 18 inches deep over hard schist, are the only soils in this subgroup.

Typic Haplaquolls are made up only of Chino soils. Although the drainage has been altered by pumping, these soils still show evidence of their former wetness, such as mottles high in the profile and gley colors (low chromas).

Vertisols are clayey soils that have deep, wide cracks at some time of the year. They shrink when dry, swell when wet, and have high bulk densities. Soil moisture is essential to the development of Vertisols. These soils generally develop in regions that have seasonal moisture changes, such as those of the Mediterranean climate, where winters are cool and wet and summers are warm and dry. In arid regions they develop in closed depressions and playas that are occasionally flooded or in areas of fine-textured soils that are wet and subject to infrequent showers. Only one great group and one subgroup are in the survey area. Typic Chromoxererts is the subgroup. Soils of this subgroup have somewhat brighter colors in the major part of all horizons than soils of the great group Pelloxererts. The Alo series of well-drained soils have been placed in this subgroup of Typic Chromoxererts.

Environmental Factors Affecting Soil Use

Among the important farm enterprises in the survey area are the farms, near Chino and Ontario, where dairying is intensive and includes the use of milking parlors. A large amount of the manure produced on dairy farms is processed and sold for use as fertilizer. Small but specialized truck farms and fresh produce farms furnish employment and income to many people. Poultry and eggs are an important part of the farming economy. Among the farm-related businesses are citrus-processing plants and local wineries that process fresh grapes.

Among the major manufacturing services are steel plants, cement plants, concrete-pipe plants, utilities companies, and those connected with the Government defense effort. A large military establishment in the survey area is Norton Air Force Base. A lumber company processes logs cut and hauled from the nearby National forest.

Transportation and shipping are furnished by airlines, buses, railroads, and truck lines. At Ontario International Airport, air service to major cities and metropolitan centers is available. Numerous State highways, new freeways, and improved secondary roads connect large and small communities throughout the entire survey area.

Relief and Drainage

The Southwestern Part of San Bernardino County is largely made up of wide, rather broad, nearly level, recent alluvial valleys and sloping, often stony, alluvial fans near the base of the San Gabriel and San Bernardino Mountains. Near Redlands there are uplifted and dissected mesalike terraces. Low hilly uplands occur west and southwest of Chino, and terrain is mountainous in the eastern part. The San Bernardino National Forest borders the area to the north and to the east. Elevation ranges from about 600 to 700 feet on the valley floors near Chino and gradually increases to about 1,200 to 1,400 feet near Redlands and San Bernardino. Pisgah Peak is about 5,400 feet high in the mountainous terrain east of Yucaipa. The Jurupa Mountains and Blue Mountain lie along the northern Riverside County line that marks the southern boundary. The Santa Ana River and its tributaries such as Lytle Creek, Cajob Wash, Oak Glen Creek, and Little San Gorgonio Creek drain most of the middle and eastern parts. In the Western parts of the area, Chino Creek, Cucamonga Creek, and San Antonio Wash are the principal drainageways. They enter the Prado Flood Control Basin that extends south into Riverside County.

Water Supply

Most of the crops that are suited to the area are dependent upon supplemental water for irrigation. Nearly all of the water for domestic, municipal, industrial, and farm use is obtained by pumping ground water. About 90 percent of the water used for crop growth is pumped from underground water basins. The remainder is diverted from surface streams. About 425,000 acre-feet of water is estimated to be used on an annual basis. In addition, about 14,000 acre-feet of water is transported annually into the area through the California River Aqueduct. When the east

branch of the California Aqueduct is in complete operation, additional amounts of water are expected to be available. A total of 46,000 acre-feet of water was contracted for delivery in 1972, but the yearly maximum entitlement is 102,600 acre-feet of water for the calendar year of 1991. The State of California, Department of Water Resources, has investigated water demands within the survey area (*4*, *5*).

Water for irrigation, which is scarce and costly, must be applied efficiently. Sprinkler irrigation is an efficient method on droughty or sloping soils. Border and furrow irrigation can be used effectively on the nearly level soils.

Climate

In San Bernardino County, Southwestern Part, summers are warm and winters are moderate. Sunshine is abundant throughout the year. Precipitation is moderate to light and occurs mostly during the colder half of the year, but snow is infrequent, except in areas at high elevation in nearby mountains. Average relative humidity is moderate to low. Winds are generally light, except for brief periods of strong winds. The strong winds are generally concentrated in areas that have northerly and northeasterly exposures.

The average daily maximum temperature is in the low 90's to the upper 90's in midsummer and in the middle 60's in winter. Average daily minimum temperature is in the upper 50's in summer and the upper 30's in winter. Temperatures of 100° or higher are fairly common in the period June through October, and temperatures of 32° or lower occur in December, January, and February in most years.

On the average, the last 32° temperature in spring is about the middle of March and the first in fall late in November. Consequently, the growing season is more than 250 days. The time between the last 28° temperature in spring and the first in fall is about 25 days longer.

Annual precipitation is 12 to 20 inches, depending on the locality. It varies considerably from year to year. For example, at San Bernardino, the annual rainfall is less than 6.5 inches in 1 year in 20 and more than 30 inches in 1 year in 20. About 90 percent of the annual precipitation is received in the period November through April.

The rates for evaporation and potential evapotranspiration are high. The potential evapotranspiration computed for the area ranges from 31 to 33 inches, but the actual rate is only 12 to 13 inches because it is limited by the distribution and amount of precipitation. Other data show that, during the growing season, the actual evapotranspiration is only 8 to 10 inches. Actual evaporation from a standard 4-foot pan is about 70 inches a year.

The relative humidity in midafternoon is in the 40° range in winter and in the upper 20's and lower 30's in summer. The sun shines 70 to 80 percent of the time, annually.

Winds blow predominantly from the southwest, but the strongest winds come from the north quadrant more frequently than from other directions. At Norton Air Force Base winds of more than 12 miles an hour blow less than 10 precent of the time and winds of more than 31 miles an hour blow 0.1 percent of the time.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY [AND TRANSPORTATION] OFFICIALS.
1970. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 10, 2 vol., illus.

(2) AMERICAN SOCIETY FOR TESTING AND MATERIALS.
1974. METHOD FOR CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) BALDWIN, MARK, KELLOGG, CHARLES E., AND THORP, JAMES.
1938. SOIL CLASSIFICATION. U.S. Dep. Agric. Yearb., pp. 979-1001, illus.

(4) CALIFORNIA DEPARTMENT OF WATER RESOURCES.
1970. MEETING WATER DEMANDS IN THE BYNKER HILL-SAN TIMOTEO AREA. Bull. 104-5, 77 pp., illus.

(5) ———
1971. MEETING WATER DEMANDS IN THE CHINO-RIVERSIDE AREA. Bull. 104-3, 27 pp., illus.

(6) CALIFORNIA DIVISION OF MINES, DEPARTMENT OF NATURAL RESOURCES.
1954. GEOLOGY OF SOUTHERN CALIFORNIA. Bull. 170, parts I and II, illus. Richard A. Jahns, ed.

(7) HANSEN, R. O., AND BEGG, E. L.
1970. AGE OF QUATERNARY SEDIMENTS AND SOILS IN THE SACRAMENTO AREA, CALIFORNIA, BY URANIUM AND ACTINIUM SERIES DATING OF VERTEBRATE FOSSILS. Earth Plane. Sci. Lett. vol. 8, No. 6, pp. 411-419, illus.

(8) HARRADINE, FRANK.
1963. MORPHOLOGY AND GENESIS OF NONCALCIC BROWN SOILS IN CALIFORNIA. Soil Sci. 96· 277-287.

(9) KELLOGG, C. E.
1963. WHY A NEW SYSTEM OF SOIL CLASSIFICATION? Soil Sci. Soc. 96: 1-5.

(10) NETTLETON, W. D., FLACH, K. W., AND BORST, G.
1968. A TOPOSEQUENCE OF SOILS IN TORNALITE GRUS IN THE SOUTHERN CALIFORNIA PENINSULA RANGE. U.S. Soil Conserv. Serv., Soil Survey. Invest. Rep. 21, 41 pp.

(11) SIMONSON, R W.
1963. SOIL CORRELATION AND THE NEW CLASSIFICATION SYSTEM. Soil Sci. 96: 23-30.

(12) SMITH, GUY D.
1963. OBJECTIVES AND BASIC ASSUMPTIONS OF THE NEW SOIL CLASSIFICATION SYSTEM. Soil Sci. 96:6-16.

(13) STORIE, RAYMOND EARL.
1953. REVISION OF THE SOIL RATING CHART. Calif. Agric. Exp. Stn., 4 pp., illus.

(14) ———
1964. HANDBOOK OF SOIL EVALUATION. Assoc. Stud. Store, Univ. Calif., Berkeley, 225 pp., Illus.

(15) THORP, JAMES.
1949. EFFECTS OF CERTAIN ANIMALS THAT LIVE IN SOILS. Sci. Mon. 68: 180-191.

(16) ——— AND SMITH, GUY D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION; ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117-126. illus.

(17) UNITED STATES DEPARTMENT OF AGRICULTURE.
1951. SOIL SURVEY MANUAL. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplement issued in May 1962.]

(18) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. 265 pp., illus. [Supplements issued in March 1967 and in September 1968.]

Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where it flows out onto a level plain or meets a slower stream.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Depth, effective rooting. The depth of soil material which plant roots can penetrate readily to obtain water and plant nutrients.

Drainage, altered. Changes in drainage commonly as the result of reclamation through artificial drainage or irrigation, but also because of the natural deepening of stream channels, the filling of depressions, or wetness caused by seepage from drainage ditches or irrigation channels.

Drainage class (natural). Refers to the condition of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Effervescence. The fizz observed when dilute hydrochloric acid is applied to a soil containing free carbonates. The amount of effervescence is divided into four classes—*very slightly effervescent, slightly effervescent, strongly effervescent,* and *violently effervescent.*

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons.

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of the soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually

underlies a C horizon but may be immediately beneath an A or B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Leaching. The removal of soluble materials from the soils by percolating water.

Leveling (of land). The reshaping, or modification, of the surface to a planned grade to permit uniform distribution of irrigation water without erosion or to provide proper surface drainage.

Lime. Chemically, lime is calcium oxide, but as the term is commonly used, it is also calcium carbonate and calcium hydroxide. Agricultural lime refers to ground limestone, hydrated lime, or burned lime, with or without magnesium minerals.

Metamorphic rocks. Rocks of any origin that have been completely changed physically by pressure, heat, and movement. Such rocks are nearly always crystalline. Examples: Mica-schist and serpentine.

Microrelief. Minor surface irregularities of the land, such as low mounds or pits.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Ped. An individual natural soil aggregate, such as a crumb, a a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Saline-alkali soil. A soil that contains a harmful quantity of salts and either a high degree of alkalinity, a large amount of exchangeable sodium, or both, so distributed in the soil profile that growth of most crop plants is less than normal.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. A rock largely composed of particles deposited from suspension in water. The chief sedimentary rocks are conglomerate, from gravel; sandstone, from sand; shale, from clay; and limestone, from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sands have been consolidated into sandstone.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are— *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflowers) wilt so much that they do not recover when placed in a dark, humid atmosphere.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read the description of the mapping unit and that of the soil series to which the mapping unit belongs. Capability grouping is explained beginning on page 27, and the capability units are described beginning on page 29. For information about the Storie Index ratings, see the section beginning on page 37. Other information is given in tables as follows:

Acreage and extent, table 1, page 6.
Estimated yields, table 2, page 35.
Engineering uses of the soils, table 4, page 40, and table 5, page 44.
Recreational uses, table 6, page 53.

Map symbol	Mapping unit	Page	Capability unit		Storie index rating
			Irrigated	Dryland	
AaF	Alo clay, 30 to 50 percent slopes	7	-------	VIe-1	16
Cb	Chino silt loam	7	I	-------	86
CkA	Chualar clay loam, 0 to 2 percent slopes	8	I	-------	77
CkC	Chualar clay loam, 2 to 9 percent slopes	8	IIe-1	-------	74
CkD	Chualar clay loam, 9 to 15 percent slopes	8	IIIe-1	-------	55
CnD	Cieneba sandy loam, 9 to 15 percent slopes	9	-------	IVe-1	26
Cp	Cieneba-Friant sandy loams	9	-------	VIIe-1	7
Cr	Cieneba-Rock outcrop complex	9	-------	VIIe-1	6
Cs2	Crafton-Rock outcrop complex, eroded	10	-------	VIIe-1	12
Db	Delhi fine sand	10	IIIe-4	-------	62
FoE	Fontana clay loam, 15 to 30 percent slopes	11	-------	IVe-1	51
FoF	Fontana clay loam, 30 to 50 percent slopes	11	-------	VIe-1	27
Fr	Friant-Rock outcrop complex	12	-------	VIIe-1	10
GaC	Garretson very fine sandy loam, 2 to 9 percent slopes	13	IIe-1	-------	95
Go	Gaviota-Rock outcrop complex	13	-------	VIIe-1	8
Gr	Grangeville fine sandy loam	14	I	-------	90
Gs	Grangeville fine sandy loam, saline-alkali	14	IIIs-6	-------	18
GtC	Greenfield sandy loam, 2 to 9 percent slopes	14	IIe-1	-------	69
GtD	Greenfield sandy loam, 9 to 15 percent slopes	15	IIIe-1	-------	61
GuD	Greenfield cobbly sandy loam, 5 to 15 percent slopes	15	IVs-7	-------	41
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes	15	IIe-1	-------	86
HaD	Hanford coarse sandy loam, 9 to 15 percent slopes	15	IIIe-1	-------	65
HbA	Hanford sandy loam, 0 to 2 percent slopes	15	I	-------	95
Hr	Hilmar loamy fine sand	16	IIe-4	-------	77
Me	Merrill silt loam	17	IIIs-8	-------	72
MgC	Metz coarse sandy loam, 2 to 9 percent slopes	18	IIIs-4	-------	77
MoC	Monserate sandy loam, 2 to 9 percent slopes	18	IIIe-8	-------	27
NaE	Nacimiento clay loam, 9 to 30 percent slopes	19	-------	IVe-1	49
NaF	Nacimiento clay loam, 30 to 50 percent slopes	19	-------	VIe-1	22
OaC	Oak Glen sandy loam, 2 to 9 percent slopes	20	IIe-1	-------	90
OgD	Oak Glen gravelly sandy loam, 9 to 15 percent slopes	20	IIIe-1	-------	54
OgE	Oak Glen gravelly sandy loam, 15 to 30 percent slopes	20	-------	IVe-1	45
Ps	Psamments and Fluvents, frequently flooded	20	-------	VIIIw-1	<10
RmC	Ramona sandy loam, 2 to 9 percent slopes	21	IIe-1	-------	60
RmD	Ramona sandy loam, 9 to 15 percent slopes	21	IIIe-1	-------	55
RmE2	Ramona sandy loam, 15 to 30 percent slopes, eroded	21	IVe-1	-------	40
SaD	San Emigdio sandy loam, 9 to 15 percent slopes	22	IIIe-1	-------	72
SbC	San Emigdio gravelly sandy loam, 2 to 9 percent slopes	22	IIe-1	-------	67
ScA	San Emigdio fine sandy loam, 0 to 2 percent slopes	22	I	-------	100
ScC	San Emigdio fine sandy loam, 2 to 9 percent slopes	22	IIe-1	-------	95
SgF2	San Timoteo loam, 30 to 50 percent slopes, eroded	23	-------	VIe-1	19
ShF	Saugus sandy loam, 30 to 50 percent slopes	23	-------	VIIe-1	7
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	24	-------	VIs-1	29
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	24	-------	VIs-1	22
SrE	Soper gravelly loam, 15 to 30 percent slopes	25	-------	VIe-1	32
SrF	Soper gravelly loam, 30 to 50 percent slopes	25	-------	VIIe-1	20
StA	Sorrento clay loam, 0 to 2 percent slopes	25	I	-------	85
StB	Sorrento clay loam, 2 to 5 percent slopes	25	IIe-1	-------	82
ToF	Tollhouse sandy loam, 30 to 50 percent slopes	26	-------	VIIe-1	12
TuB	Tujunga loamy sand, 0 to 5 percent slopes	26	IIIe-4	-------	70
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes	26	IVs-4	-------	34
Vr	Vista-Rock outcrop complex	27	-------	VIIe-1	16

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Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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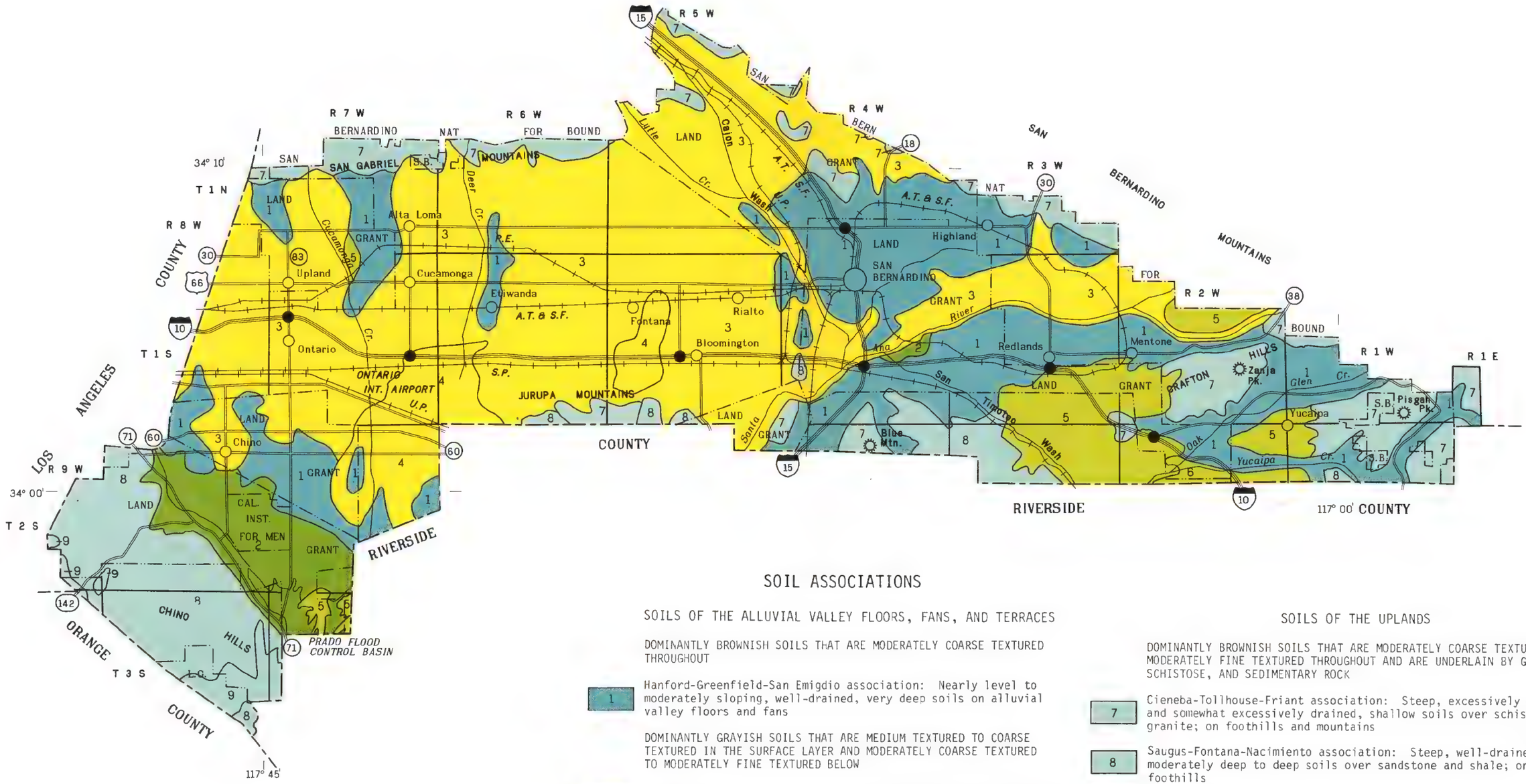


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CALIFORNIA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

SAN BERNARDINO COUNTY, CALIFORNIA

SOUTHWESTERN PART

Scale 1: 253,440

1 0 1 2 3 4 5 Miles

SOIL ASSOCIATIONS

SOILS OF THE ALLUVIAL VALLEY FLOORS, FANS, AND TERRACES

DOMINANTLY BROWNISH SOILS THAT ARE MODERATELY COARSE TEXTURED THROUGHOUT

1 — Hanford-Greenfield-San Emigdio association: Nearly level to moderately sloping, well-drained, very deep soils on alluvial valley floors and fans

DOMINANTLY GRAYISH SOILS THAT ARE MEDIUM TEXTURED TO COARSE TEXTURED IN THE SURFACE LAYER AND MODERATELY COARSE TEXTURED TO MODERATELY FINE TEXTURED BELOW

2 — Grangeville-Chino-Hilmar association: Nearly level, somewhat poorly drained, very deep soils in basins and on alluvial flood plains and fans

DOMINANTLY BROWNISH SOILS THAT ARE COARSE TEXTURED THROUGHOUT

3 — Tujunga-Soboba association: Nearly level to moderately sloping, somewhat excessively drained and excessively drained, very deep soils on alluvial valley floors

4 — Delhi association: Nearly level to strongly sloping, somewhat excessively drained, very deep soils on alluvial fans

DOMINANTLY BROWNISH SOILS THAT ARE MODERATELY COARSE TEXTURED OR MODERATELY FINE TEXTURED IN THE SURFACE LAYER AND MODERATELY FINE TEXTURED BELOW

5 — Ramona-Chualar-Sorrento association: Nearly level to moderately sloping, well-drained, very deep soils on alluvial fans and terraces

6 — Ramona association: Strongly sloping to moderately steep, well-drained, very deep soils on terraces

SOILS OF THE UPLANDS

DOMINANTLY BROWNISH SOILS THAT ARE MODERATELY COARSE TEXTURED OR MODERATELY FINE TEXTURED THROUGHOUT AND ARE UNDERLAIN BY GRANITIC, SCHISTOSE, AND SEDIMENTARY ROCK

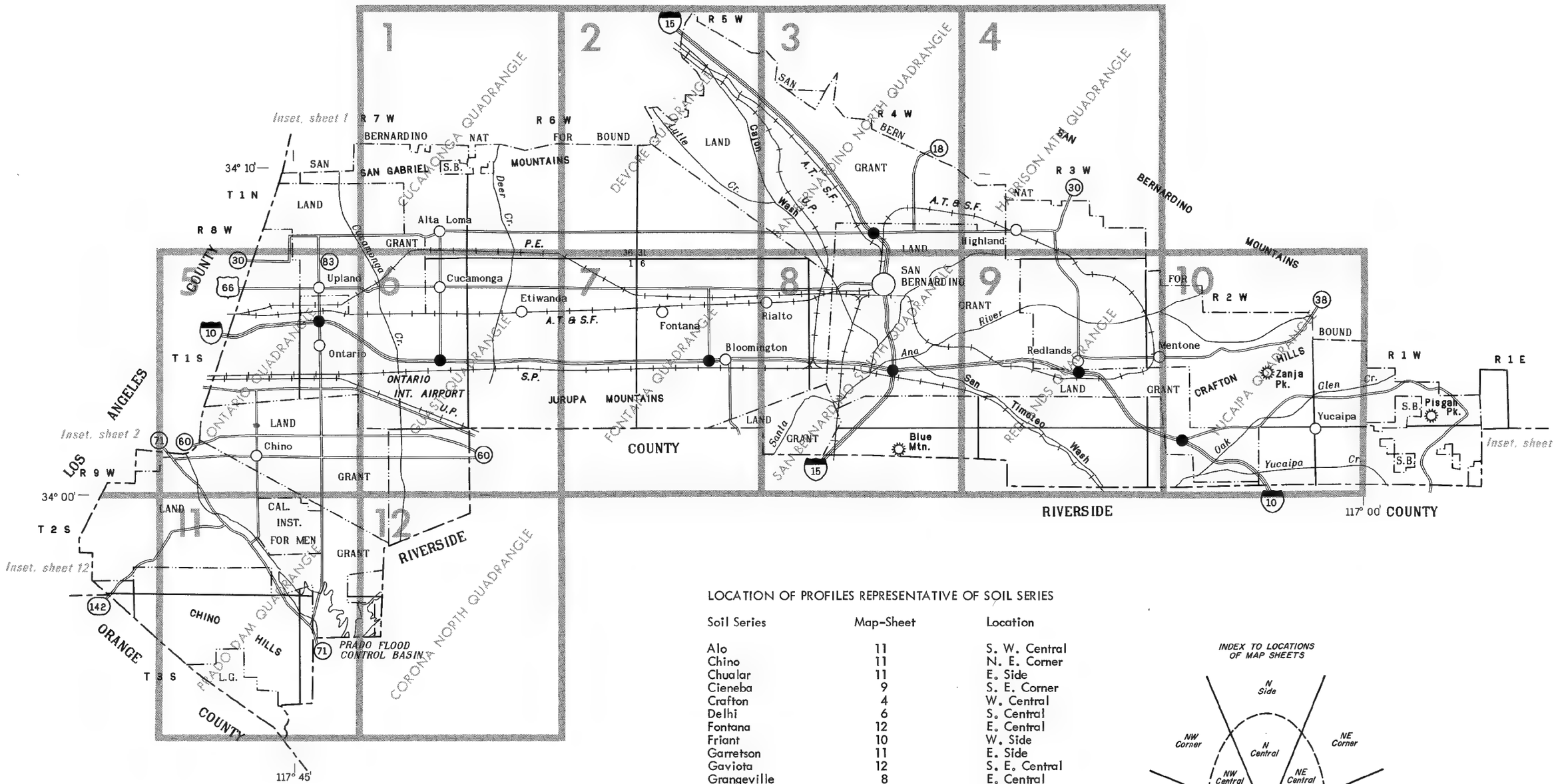
7 — Cieneba-Tollhouse-Friant association: Steep, excessively drained and somewhat excessively drained, shallow soils over schist and granite; on foothills and mountains

8 — Saugus-Fontana-Nacimiento association: Steep, well-drained, moderately deep to deep soils over sandstone and shale; on foothills

9 — Gaviota-Rock outcrop association: Steep, somewhat excessively drained, shallow soils over hard sandstone, and sandstone rock outcrops; on foothills

Compiled 1977

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

SAN BERNARDINO COUNTY, CALIFORNIA

SOUTHWESTERN PART

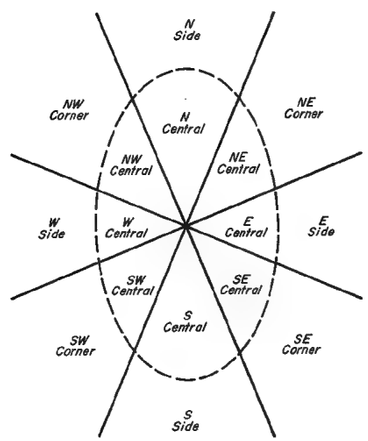
Scale 1:253,440

1 0 1 2 3 4 5 Miles

LOCATION OF PROFILES REPRESENTATIVE OF SOIL SERIES

Soil Series	Map-Sheet	Location
Alo	11	S. W. Central
Chino	11	N. E. Corner
Chualar	11	E. Side
Cieneba	9	S. E. Corner
Crafton	4	W. Central
Delhi	6	S. Central
Fontana	12	E. Central
Friant	10	W. Side
Garretson	11	E. Side
Gaviota	12	S. E. Central
Grangeville	8	E. Central
Greenfield	10	E. Side
Hanford	9	N. W. Central
Hilmar	12	N. W. Corner
Merrill	11	N. Side
Metz	9	S. Side
Monserate	8	S. W. Central
Nacimiento	12	E. Side
Oak Glen	4	N. Central
Ramona	9	S. W. Central
San Emigdio	9	S. W. Central
San Timoteo	10	S. W. Corner
Saugus	9	S. E. Corner
Soboba	10	W. Side
Soper	11	N. Central
Sorrento	11	N. Central
Tollhouse	4	N. W. Central
Tujunga	9	N. Side
Vista	8	S. W. Central

INDEX TO LOCATIONS OF MAP SHEETS



SOIL LEGEND

The first letter, always a capital, is the initial letter of the soil name. A second capital letter, A, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for complexes or land types that have a considerable range in slope. A final number, 2, in the symbol shows that the soil is eroded.

SYMBOL	NAME
AaF	Alo clay, 30 to 50 percent slopes
Cb	Chino silt loam
CkA	Chualar clay loam, 0 to 2 percent slopes
CkC	Chualar clay loam, 2 to 9 percent slopes
CkD	Chualar clay loam, 9 to 15 percent slopes
CnD	Cieneba sandy loam, 9 to 15 percent slopes
Cp	Cieneba-Friant sandy loams
Cr	Cieneba-Rock outcrop complex
Cs2	Crafton-Rock outcrop complex, eroded
Db	Delhi fine sand
FoE	Fontana clay loam, 15 to 30 percent slopes
FoF	Fontana clay loam, 30 to 50 percent slopes
Fr	Friant-Rock outcrop complex
GaC	Garretson very fine sandy loam, 2 to 9 percent slopes
Go	Gaviota-Rock outcrop complex
Gr	Grangeville fine sandy loam
Gs	Grangeville fine sandy loam, saline-alkali
GtC	Greenfield sandy loam, 2 to 9 percent slopes
GtD	Greenfield sandy loam, 9 to 15 percent slopes
GuD	Greenfield cobbly sandy loam, 5 to 15 percent slopes
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes
HaD	Hanford coarse sandy loam, 9 to 15 percent slopes
HbA	Hanford sandy loam, 0 to 2 percent slopes
Hr	Hilmar loamy fine sand
Me	Merrill silt loam
MgC	Metz coarse sandy loam, 2 to 9 percent slopes
MoC	Monserate sandy loam, 2 to 9 percent slopes
NaE	Nacimiento clay loam, 9 to 30 percent slopes
NaF	Nacimiento clay loam, 30 to 50 percent slopes
OaC	Oak Glen sandy loam, 2 to 9 percent slopes
OgD	Oak Glen gravelly sandy loam, 9 to 15 percent slopes
OgE	Oak Glen gravelly sandy loam, 15 to 30 percent slopes
Ps	Psamments and Fluvents, frequently flooded
RmC	Ramona sandy loam, 2 to 9 percent slopes
RmD	Ramona sandy loam, 9 to 15 percent slopes
RmE2	Ramona sandy loam, 15 to 30 percent slopes, eroded
SaD	San Emigdio sandy loam, 9 to 15 percent slopes
SbC	San Emigdio gravelly sandy loam, 2 to 9 percent slopes
ScA	San Emigdio fine sandy loam, 0 to 2 percent slopes
ScC	San Emigdio fine sandy loam, 2 to 9 percent slopes
SgF2	San Timoteo loam, 30 to 50 percent slopes, eroded
ShF	Saugus sandy loam, 30 to 50 percent slopes
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes
SpC	Soboba stony loamy sand, 2 to 9 percent slopes
SrE	Soper gravelly loam, 15 to 30 percent slopes
SrF	Soper gravelly loam, 30 to 50 percent slopes
StA	Sorrento clay loam, 0 to 2 percent slopes
StB	Sorrento clay loam, 2 to 5 percent slopes
ToF	Tollhouse sandy loam, 30 to 50 percent slopes
TuB	Tujunga loamy sand, 0 to 5 percent slopes
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes
Vr	Vista-Rock outcrop complex

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit (G.P.)
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

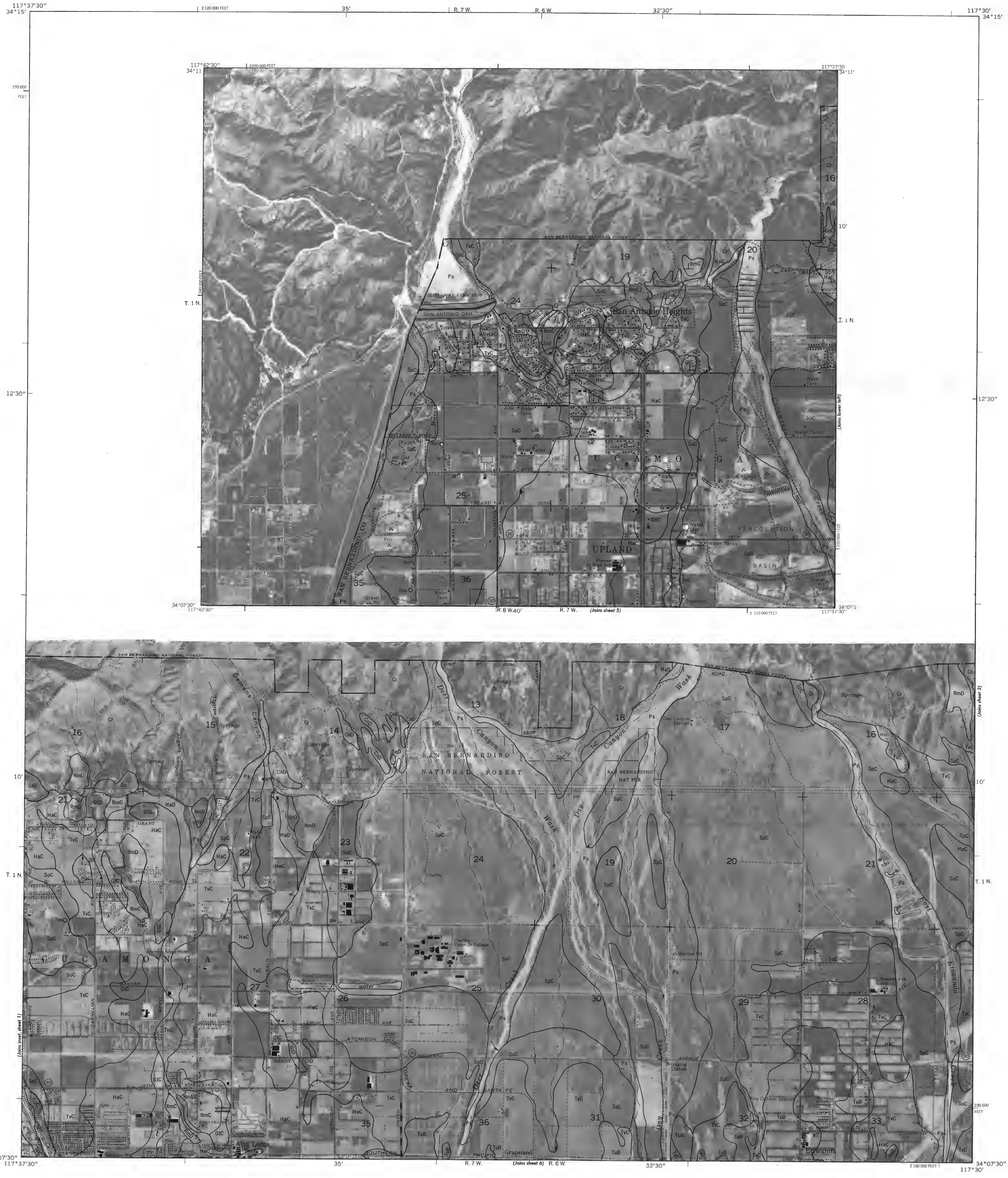
SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Borrow pit (B.P.)
- Glacial till

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 1
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(CUCAMONGA PEAK QUADRANGLE AND PART OF MT. BALDY QUADRANGLE)



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

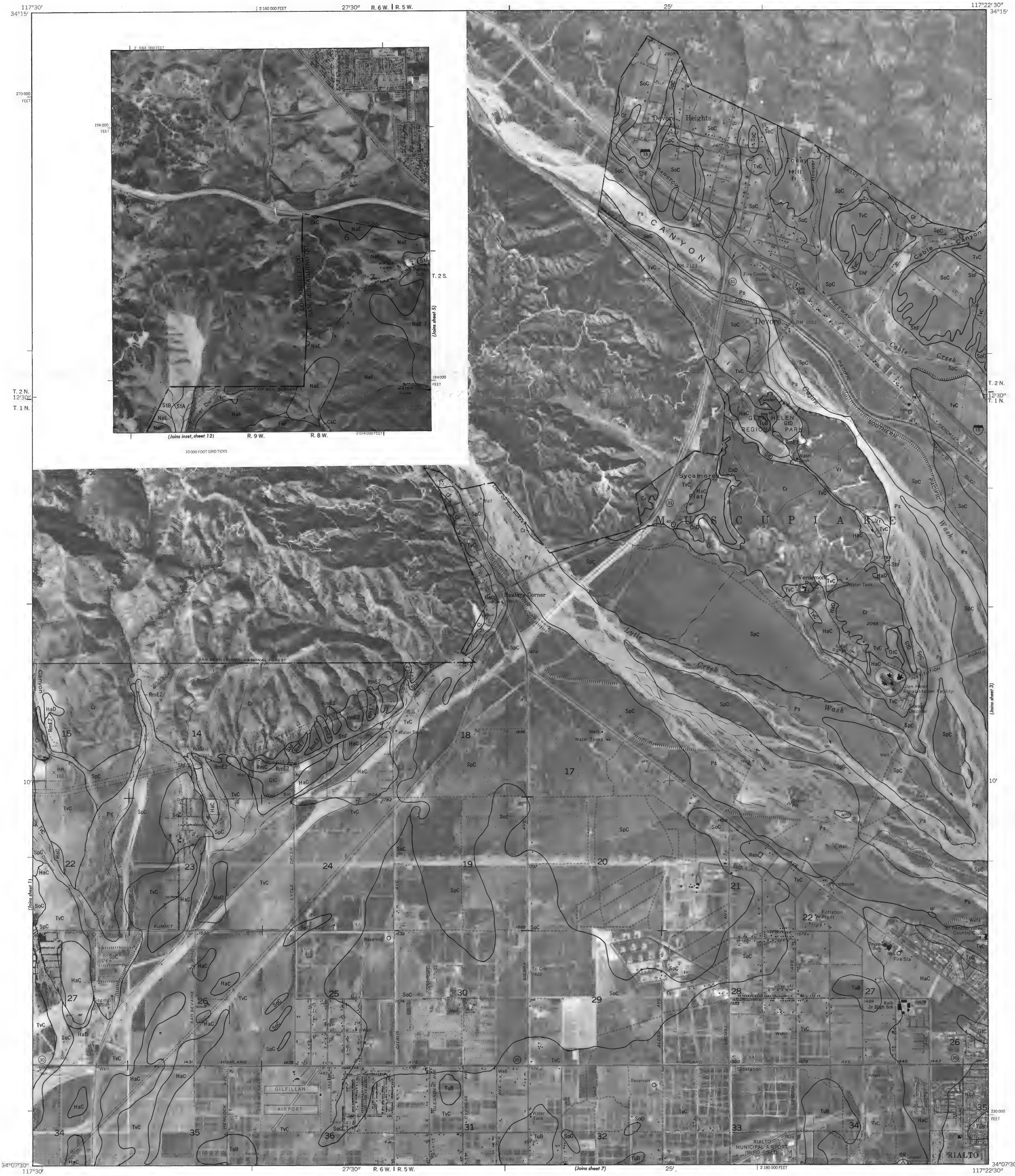
1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 1

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 2
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(DEVORE QUADRANGLE AND PART OF SAN DIMAS QUADRANGLE)



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1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

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SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 3
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(SAN BERNARDINO NORTH QUADRANGLE)

117°22'30" 2 190 000 FEET R. 5 W. R. 4 W. 20' 17'30" 117°15'
34°15' 34°15'
270 000 FEET
T. 2 N. T. 2 N.
12'30" 12'30"
T. 1 N. T. 1 N.
(Joins sheet 2)
10' 10'
(Joins sheet 8)
34°07'30" 34°07'30"
117°22'30" 2 220 000 FEET 117°15'

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

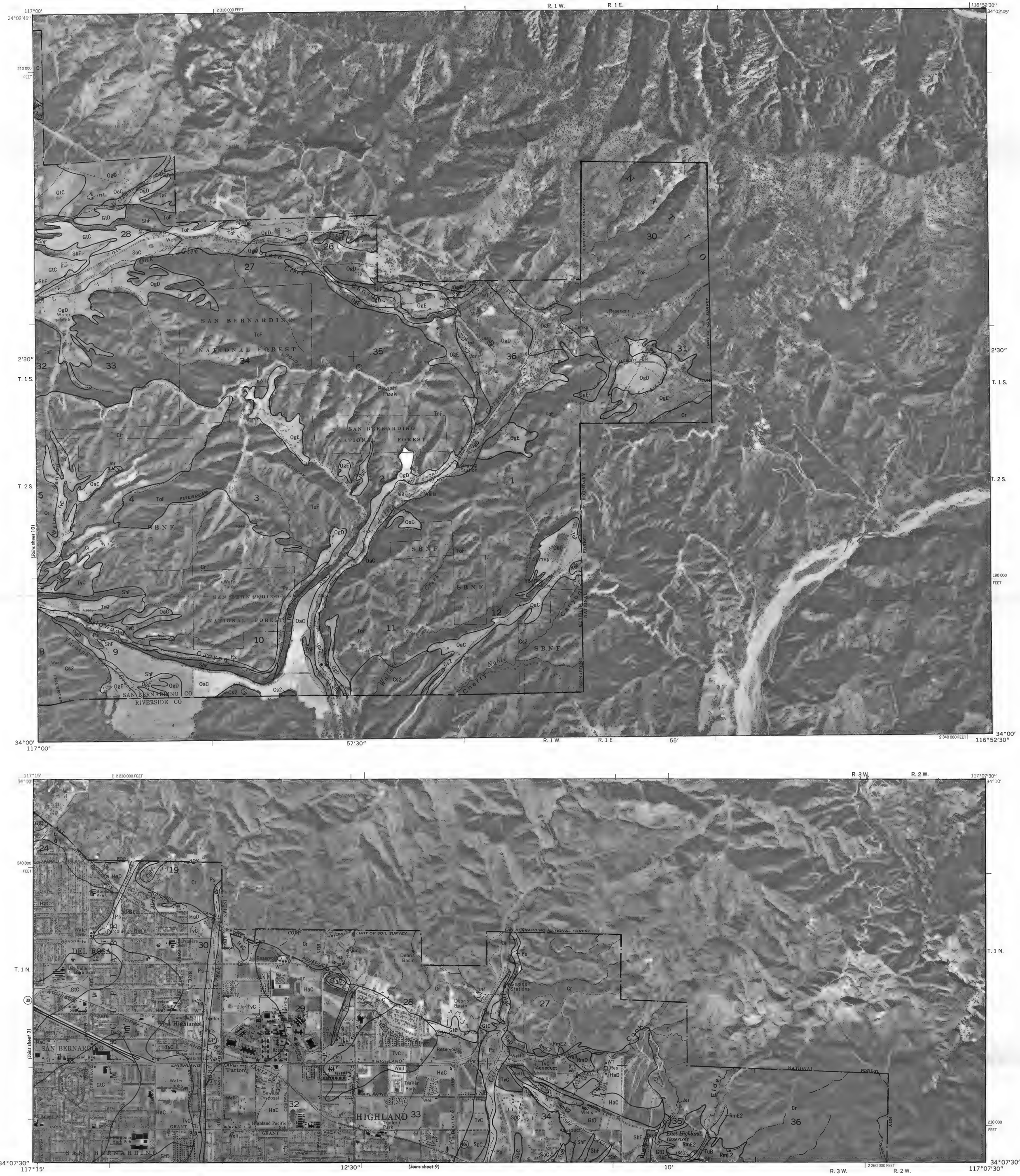
1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 3

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 4
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(FOREST FALLS AND HARRISON MTN. QUADRANGLES)



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 4

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 5
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(ONTARIO QUADRANGLE)

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 5

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO 6
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(GUASTI QUADRANGLE)

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 6

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 7
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(FONTANA QUADRANGLE)

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

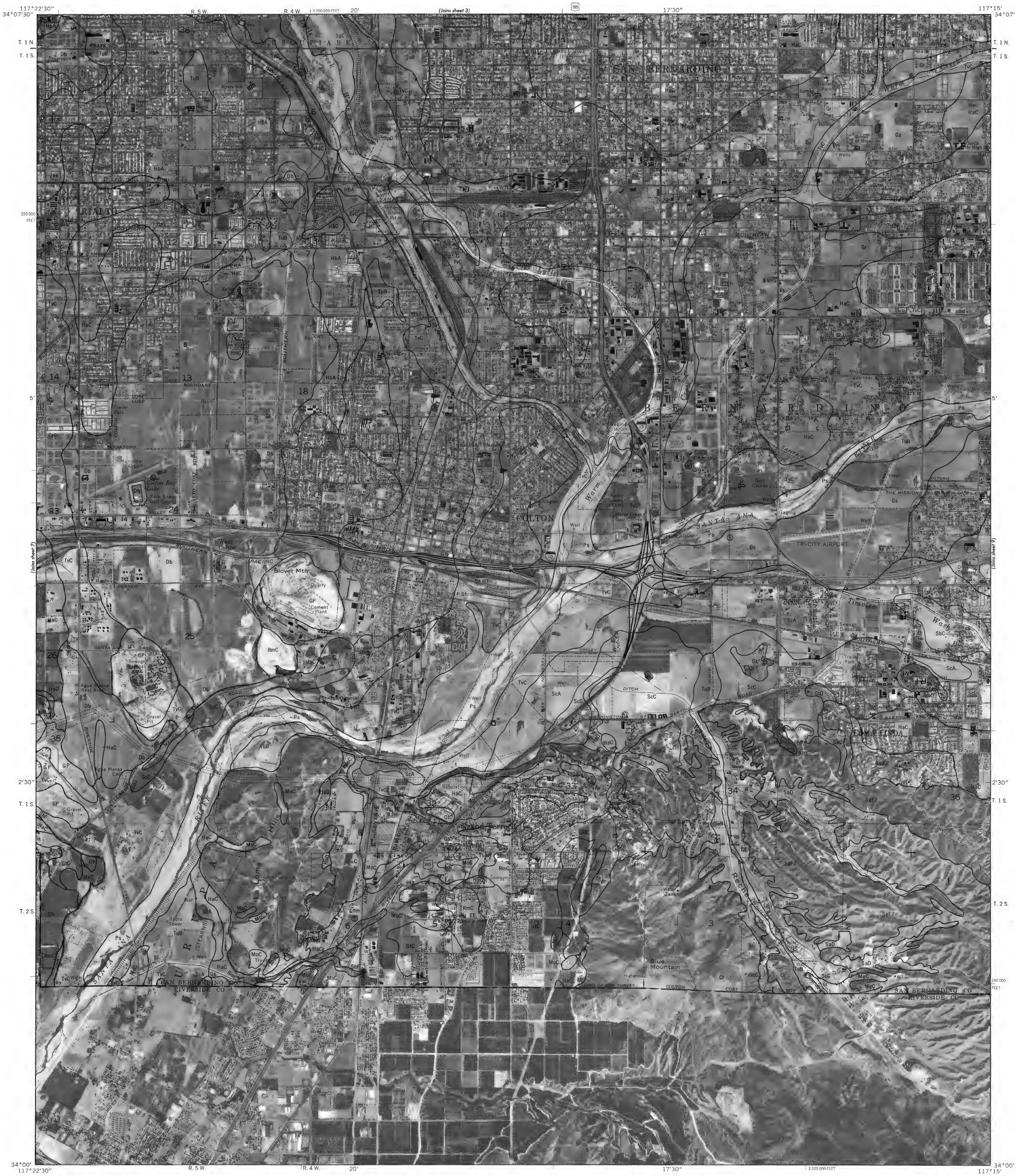
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 7

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 8
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(SAN BERNARDINO SOUTH QUADRANGLE)



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

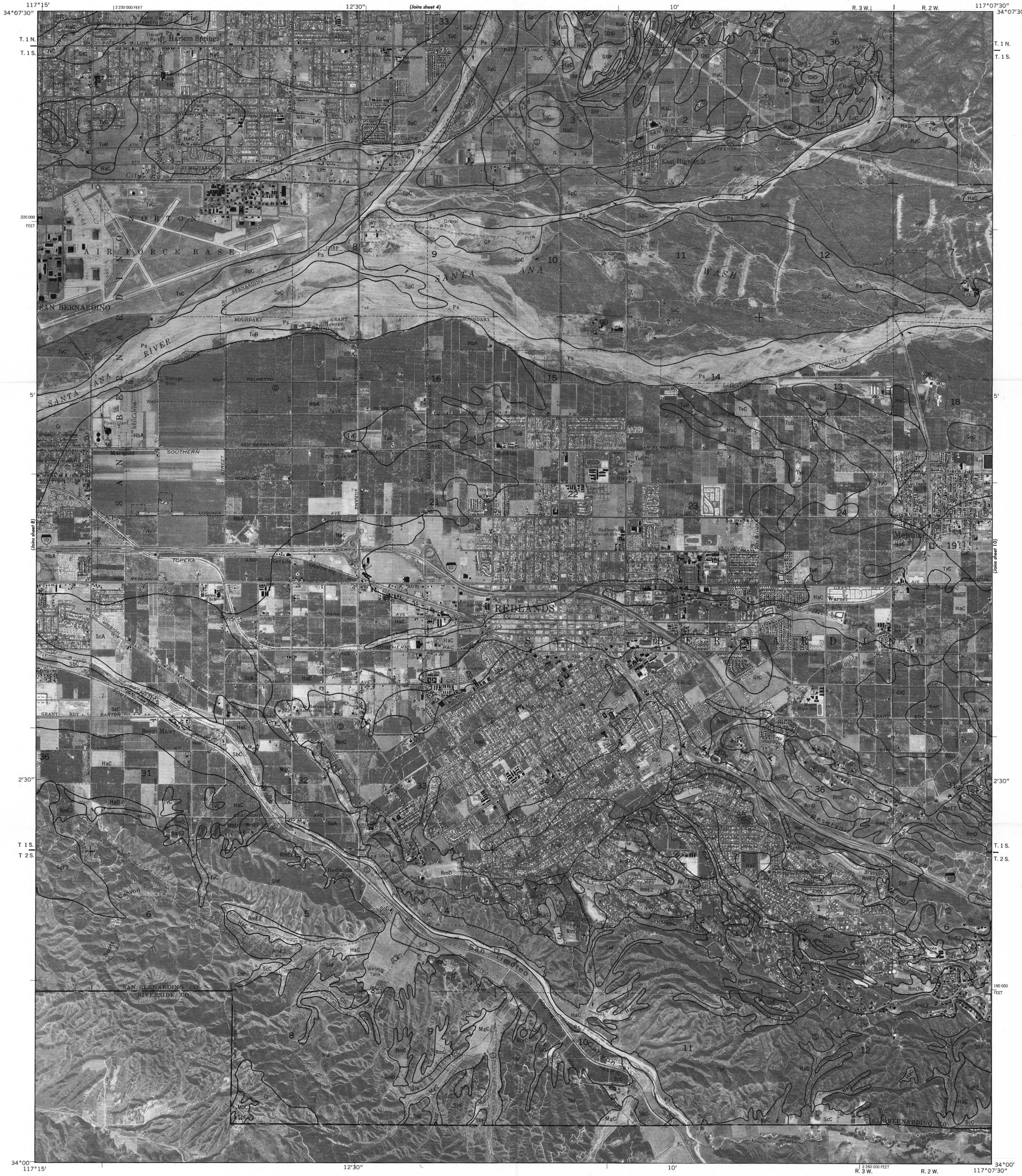
1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior Geological Survey
Planimetric detail obtained from 7½ minute series maps
10,000-foot grid based on state coordinate system

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 8

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 9
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(REDLANDS QUADRANGLE)



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 9

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 10
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(YUCAIPA QUADRANGLE)

117°07'30" 34°07'30" 2 270 000 FEET 5' 2'30" R. 2 W. R. 1 W. 117°00' 34°07'30"

T. 1 N. T. 1 S. T. 2 S.

220 000 FEET 190 000 FEET

2'30" 5' 34°00' 117°07'30" 2 300 000 FEET 117°00'

(Joins sheet 9) (Joins inset, sheet 4)

REDLANDS MENTONE CRAFTON YUCAIPA CALIMESA SAN BERNARDINO RIVERSIDE CO

Mill Creek Zanja Creek Oak Glen Creek Wildwood Canyon Creek Live Oak Canyon Creek

SAN BERNARDINO NATIONAL FOREST

Crafton Reservoir Zanja Peak Mill Creek Ranger Station Powerhouse Gaging Station Flume Water Tanks Trailer Parks Mentone Sch. Yucaipa High Sch. Dunlap Sch. Calimesa Sch. Jackson Ranch Flood Control Basin

SpC HaC HaD ShF RmD RmE2 RmC GtC Ps Cr TvC GtD GuD Cp ScC SgF2 SaD TuB ToF OgD Cs2

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 Scale 1:24000 5000 10 000 Feet

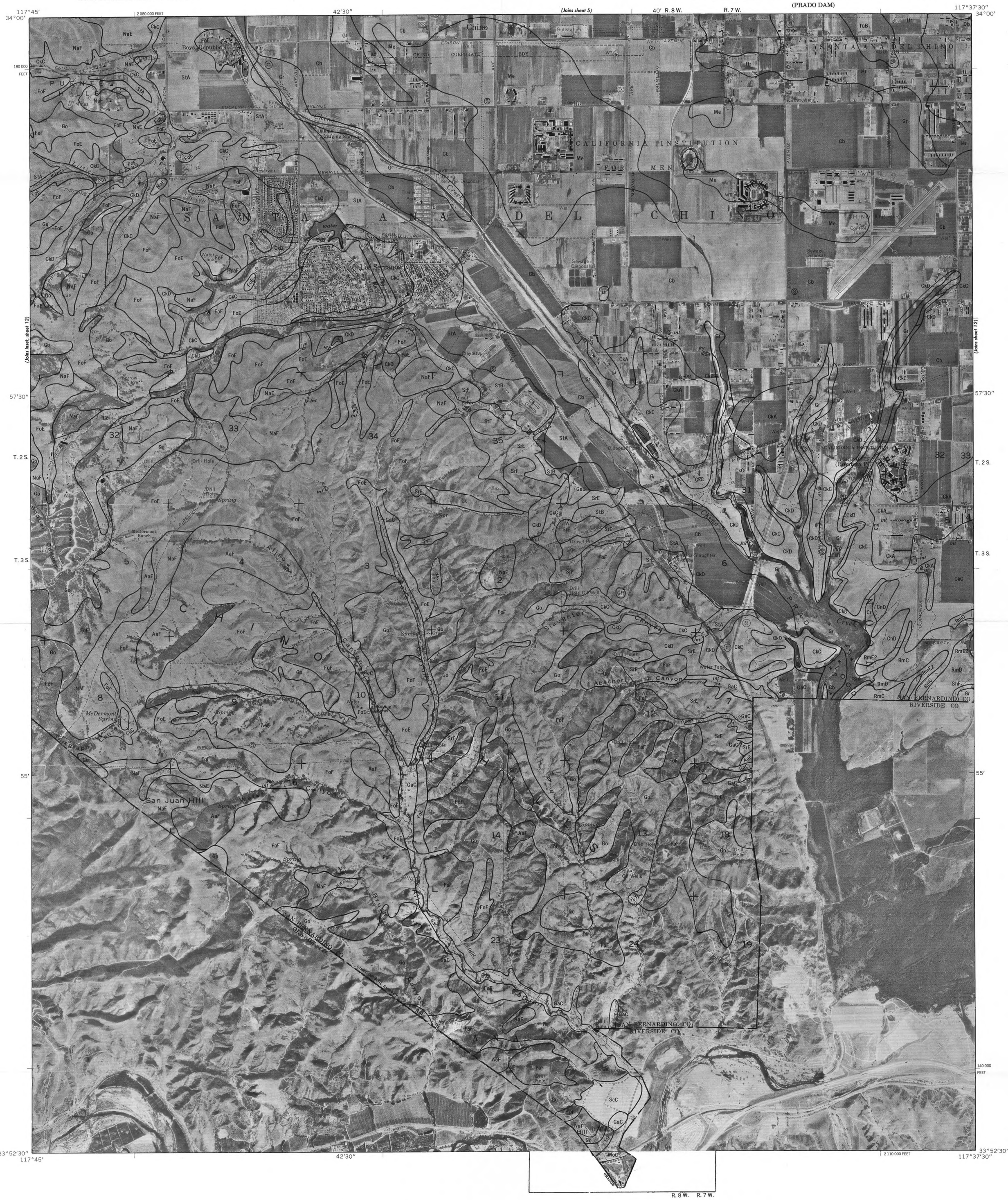
Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 10

SHEET NO. 10 OF 12

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 11
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(PRADO DAM)



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

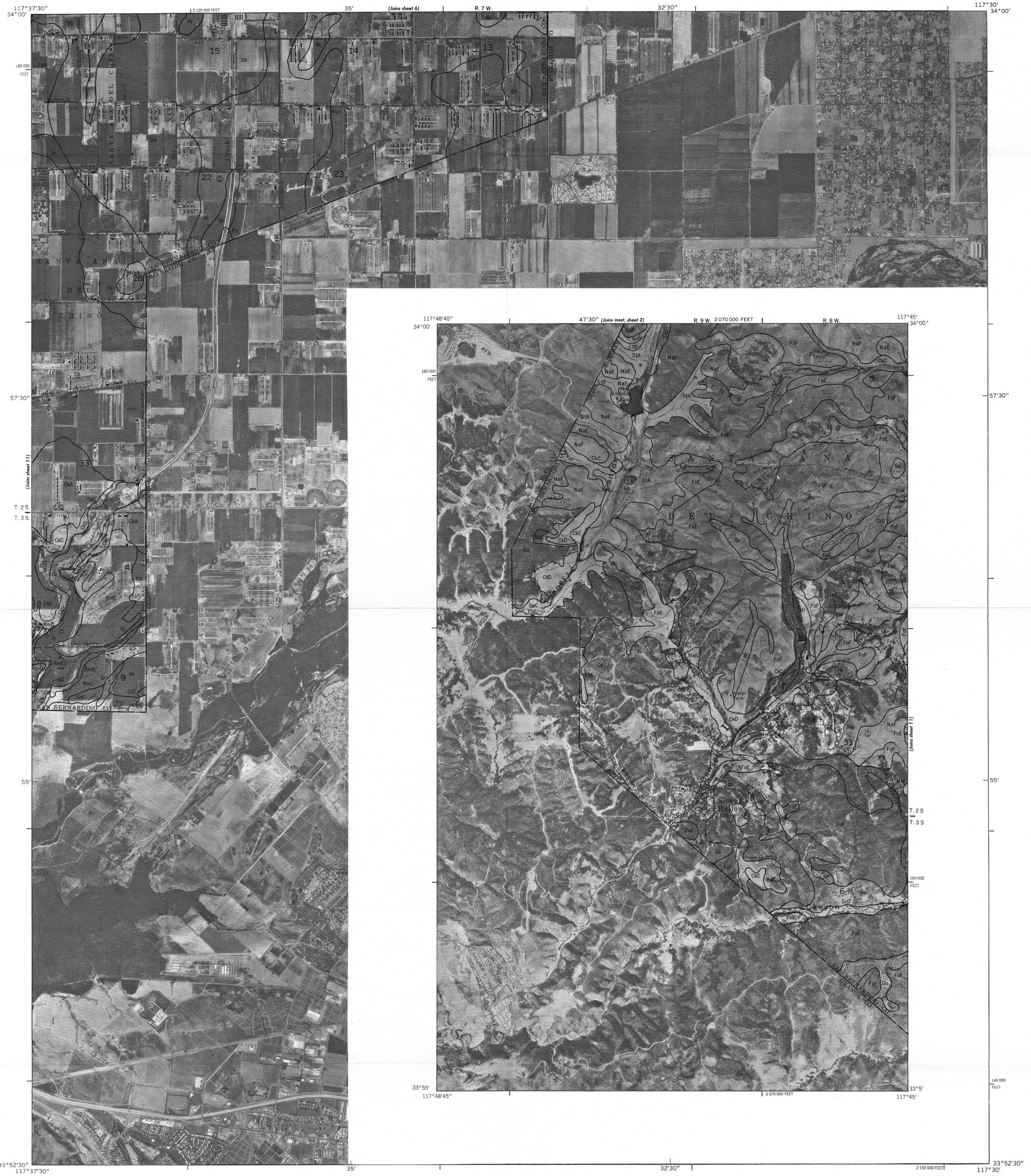
1 ⅝ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 11

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 12
SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA
(CORONA NORTH QUADRANGLE AND PART OF YORBA LINDA QUADRANGLE)



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

SAN BERNARDINO COUNTY, SOUTHWESTERN PART, CALIFORNIA NO. 12